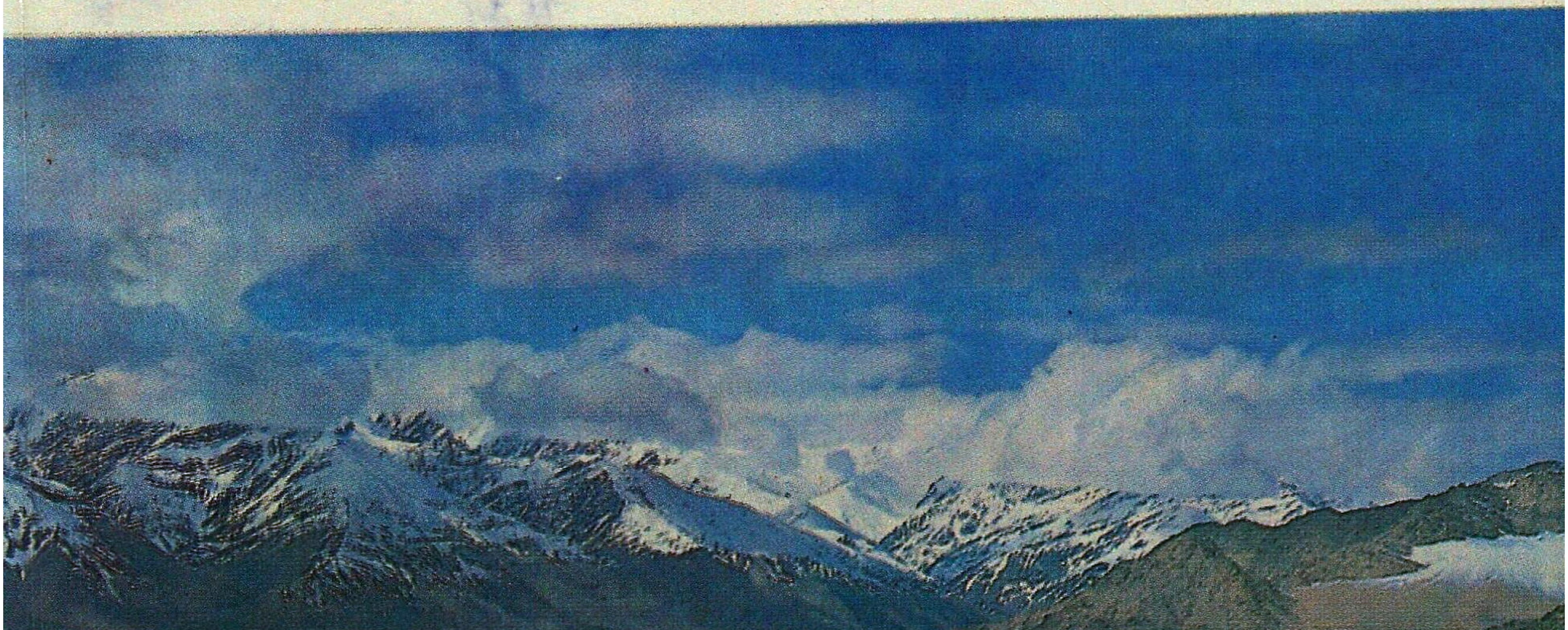
355

THE INDIAN FORESTER

(FOUNDED IN 1875)



VOL. 115 APRIL 1989 NO. 4

Telegram: Indian Forester
Telephone : 27021/264

INDIAN FORESTER

(A Monthly Journal of Forestry and Forestry Research)

BOARD OF MANAGEMENT

Chairman—A.G. OKA, I.F.S., Inspector General of Forests, Govt. of India, New Delhi.
Vice Chairman—R.V. SINGH, I.F.S., Director General, Indian Council of Forestry Research & Education, Dehra Dun.

MEMBERS

Andamans : S.S. CHANA, I.F.S., Andhra Pradesh : K.V.S. BABU, I.F.S. : Arunachal Pradesh : P.P. MALHOTRA, I.F.S.; Assam : S. DEB ROY, I.F.S.; Bihar : R.P. SINGH, I.F.S.; Dadar & Nagarhaveli; H.C. DHAWAN, I.F.S.; Goa : PANDEY B.P. SINHA, I.F.S.; Gujarat : M.N. VAISNAV, I.F.S. Haryana : GURNAM SINGH, I.F.S.; Himachal Pradesh : A.K. MUKERJI, I.F.S.; Jammu & Kashmir : EJAJ AHMED MALIK, I.F.S.; Karnataka : S. SHYAM SUNDER, I.F.S.; Kerala : M. SIVARAJAN, I.F.S.; Maharashtra : U.B. PATIL, I.F.S.; Madhya Pradesh : V.B. SAHARIA, I.F.S.; Manipur : B.S.K. SARMA, I.F.S.; Meghalaya : A. WAHLANG, I.F.S.; Mizoram : S.R. MEHTA, I.F.S., Nagaland : K.I. AO, I.F.S.; Orissa : S.C. PADHI, I.F.S.; Punjab : S.K. KAPUR, I.F.S.; Rajasthan : K.K. KOTIA, I.F.S.; Sikkim : P.K. BASANETT, I.F.S.; Tamil Nadu : S. JOHN JOSEPH, I.F.S.; Tripura : M. SARKAR, I.F.S.; Uttar Pradesh : HARI KANT, I.F.S.; West Bengal : B.K. BARDHAN ROY, I.F.S.

RULES OF MANAGEMENT

1. *Pre-Payable Annual Subscription :—*

INDIA (Inclusive of Postage)	FOREIGN	SINGLE COPY (Current and Back issue) (Exclusive of Postage)
Rs. 250.00	$ 100.00 (By Sea Mail) $ 150.00 (By Air Mail)	India Rs. 25.00, Foreign $ 10.00

Note :—Subscriptions are generally booked for Calendar Year (JANUARY-DECEMBER), and/or from JULY-JUNE. Copies for intermediate months (of current issue) can, however, be supplied on payment. if available.

2. *Concessional Rates of Annual Subscription* (Applicable to Serving Forest Officers & Forest Scientists in Government Institutes and Government Departments in India only) :—
Those drawing a Salary of less than Rs. 2000.00 p.m. .. .. Rs. 125.00 per Annum

3. *Life Subscription :*—Forest Officers, on retirement from service in India, can obtain copies of the *Indian Forester* for life by one Single Payment of Rs. 500.00 or its equivalent. A life Subscriber will be enrolled as such hand entitled to receive copies of the Journal from the date of receipt of the full amount of his Life subscription. Request for back numbers of the Journal will not be entertained. These can, however, be supplied if available, on payment fixed for back numbers.

4. *Advertisement Tariff:*—(The rates are exclusive of blocks, etc. and are liable to change WITHOUT NOTICE) All Advertisement Matter is strictly subject to the approval of the Management.

N.B.—The Table below shows Contract Rates for and over SIX and TWELVE Insertions respectively to be consumed in one YEAR or THREE Insertions booked at a time and printed in three successive Issues of the Journal. The figures in the right-hand column denote Charges for Casual and Single Insertions.

Space	12 Insertions	6 Insertions	3 Insertions	Casual (Per Insertion)
Full Page	Rs. 3000.00	Rs. 1600.00	Rs. 900.00	Rs. 300.00
Half Page	Rs. 1800.00	Rs. 1000.00	Rs. 600.00	Rs. 200.00
Quarter Page	Rs. 1200.00	Rs. 750.00	Rs. 450.00	Rs. 160.00
2.5 c.m. Across Page	Rs. 1000.00	Rs. 600.00	Rs. 400.00	Rs. 140.00

Note :—(1) Extra charges over the above Rates for (*a*) Multi-Colour Insertions (up to four colours only) 75% (*b*) Double-colour (Red only or Red and Black)—25%; (*c*) Advertisement on Art Paper—25%

(2) Half-tone and Line Blocks, Stereos, and Matrices accepted, Blocks of all description and/or other Advertisements material are to be supplied by the Advertising parties themselves.

(3) Screen used for Advertisements : 80—100.

(4) Only one *Voucher Copy* will be supplied Overall Size : 24 cm × 18.5 cm; Printing Size (Full-page) 20 cm × 15 cm.

Important—(*a*) Advertisement charges are strictly Payable in advance preferably by a bank Draft on State Bank of India, Dehra Dun, U.P. (India; and drawn in favour of the Business Manager *Indian Forester* (*b*). The Advertisement matter, which should be TYPEWRITTEN IN BLOCK LETTERS and should be sent in DUPLICATE. For further particulars and terms of business please apply to the Business Manager, *Indian Forester*.

(5) Correspondence concerning subscriptions, etc., should be addressed to the Business Manager *Indian Forester*, P.O. New Forest, Dehra Dun (India). All payments on account of Subscriptions and Advertisement, etc., must, however, be made in the name of the Business Manager. *Indian Forester* and Cheques, etc., drawn in his favours.

(6) All complaints regarding delay in receipt or non-delivery of a copy or copies of the *Indian Forester* should be made WITHIN 30 DAYS from the due date of publication of an issue which is 1st of each month to the Business Manager, *Indian Forester*, P.O. New Forest, Dehra Dun. Efforts will be made to supply duplicate copy or copies of the missing number, *free of cost*, provided a complaint is received in time, and on payment if a complaint is received after 30 days subject to the availability of a copy or copies in stock in their case.

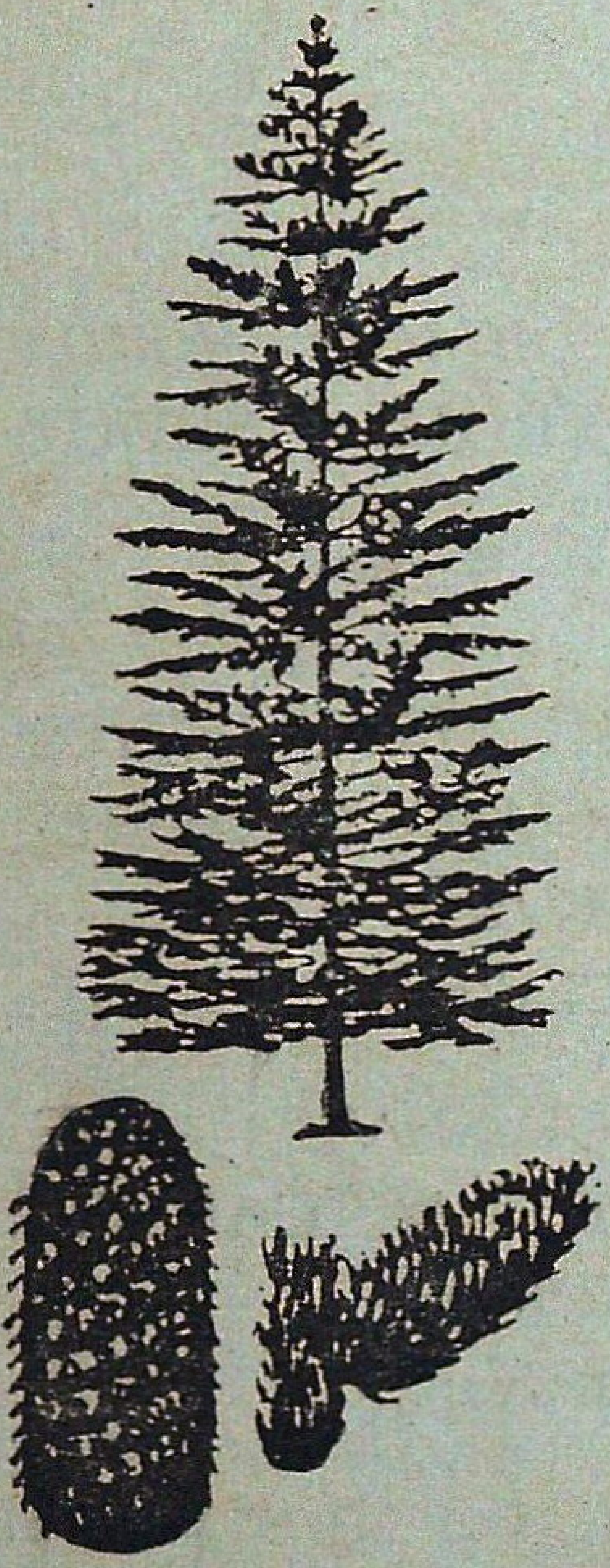
(7) In case of dispute, Dehra Dun U.P. (India), shall be the place of jurisdiction.

Lib. No: 355.

THE INDIAN FORESTER

Volume 115 No. 4

APRIL, 1989



COVER PHOTO

GREENING OF COLD DESERT OF LADAKH. LEH 3500 M ASL ON THE BANK OF RIVER INDUS TURNED INTO A GREEN OASIS BY PLANTING POPLARS AND WILLOWS.

Photo—Pratap Singh

CONTENTS

ARTICLES

FAST GROWING SPECIES FOR MEETING RURAL AND INDUSTRIAL NEEDS OF PUNJAB—PRESENT STATUS AND FUTURE RESEARCH NEEDS.
S K. Kapur and A.S. Dogra 201

STUDIES ON THE PERFORMANCE OF PHILLIPINES AND MALAYSIAN PROVENANCES OF *ALBIZIA FALCATARIA* (L) FORBERG AT NURSERY STAGE UNDER NORTH INDIAN MOIST TROPICAL CONDITION.
V.K. Bahuguna, K.P. Unnikrishnan and U.C. Dhaundiyal 209

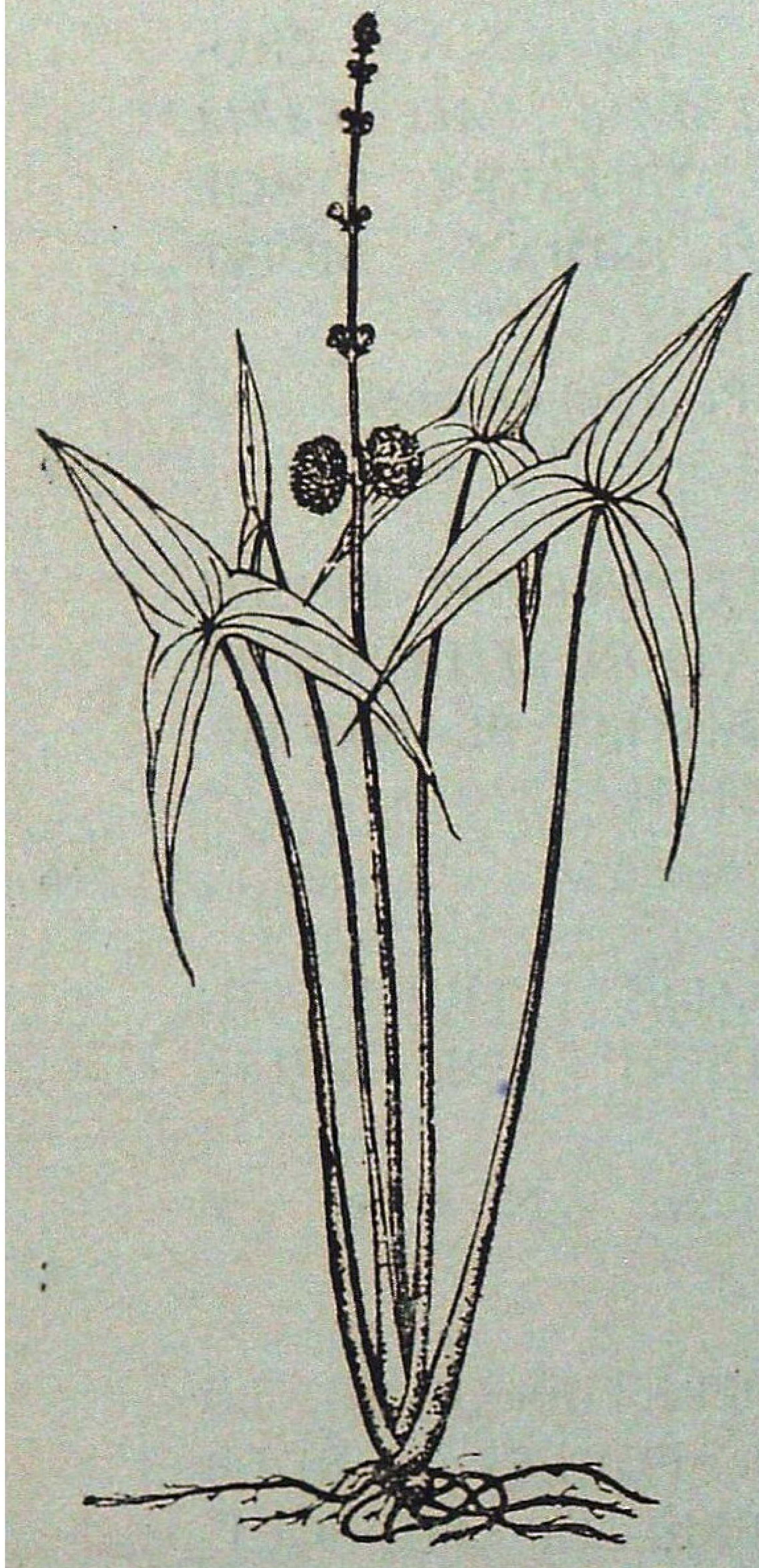
OBSERVATIONS ON FLOWERING, FRUITING AND GERMINATION BEHAVIOURS OF SOME USEFUL FOREST PLANTS OF ARUNACHAL PRADESH.
B.S. Beniwal and N.B. Singh 216

DISEASES OF FOREST TREES IN HIMACHAL PRADESH AND THEIR CONTROL.
H S. Sehgal, R.K. Tivari, S.N. Khan and B M. Misra 228

SOIL CHEMICAL PROPERTIES OF SILVER FIR AND SPRUCE FOREST UNDER DIFFERENT SYSTEMS OF SILVICULTURE I—CHANGES IN SOIL NITROGEN
M.K. Gupta, R.P. Singh and M N. Jha ... 235

ROLLING OF LOGS IN FELLING COUPES : A POTENTIAL DISEASE HAZARD IN CONIFEROUS FORESTS.
Sujan Singh and P.C. Pandey 243

PHENOLOGICAL ASPECT OF MADHAULIA FOREST, GORAKHPUR.
A.A. Ansari 250



BIONOMICS AND CONTROL OF TENDU DEFOLIATOR *HYPOCALA ROSTRATA* L. (LEPIDOPTERA : NOCTUIDAE).
Sushil Kumar, Lalji Prasad and H.R. Khan ... 258

IN-VITRO ANTIMICROBIAL ACTIVITY OF ESSENTIAL OIL OF NEWLY EVOLVED *EUCALYPTUS* HYBRID FRI-5.
D C. Chaudhari, C L. Goel, R.K. Suri and P.K. Deshmukh 264

A NEW LEAF SPOT DISEASE OF *DERRIS ROBUSTA*.
M D. Mehrotra and G S. Sarma 268

RESEARCH NOTES

I—PERFORMANCE OF *ACACIA ALBIDA* PLANTS RAISED FROM SHOOT CUTTINGS.
Parvez Ahmed 270

II—CHANGES IN SOIL PROPERTIES UNDER *ACACIA AURICULIFORMIS* PLANTATIONS IN TRIPURA.
R.N. Chakraborty and D. Chakraborty ... 272

III—LEAF BLIGHT DISEASE OF *EUCALYPTUS TERETICORNIS* CAUSED BY *ALTERNARIA PADWICKII*.
L. Thankanma and J. Madhavan Natr ... 274

IV—*AZADIRACHTA INDICA* A JUSS., THE HOST OF *FICUS RELIGIOSA* LINN.
K.J. Vyas 276

LETTER TO THE EDITOR

TIGER WITHOUT STRIPES.
S.R. Sagar and L.A.K. Singh 277

GAZETTE NOTIFICATIONS 279

VOLUME 115 NUMBER 4

THE
INDIAN FORESTER

APRIL, 1989

FAST GROWING SPECIES FOR MEETING RURAL AND INDUSTRIAL NEEDS OF PUNJAB—PRESENT STATUS AND FUTURE RESEARCH NEEDS

S.K. KAPUR* AND A.S. DOGRA**

Introduction

Punjab is predominantly an agricultural state with about 84% of the total area under cultivation. With the spread of irrigation, cultivation of agricultural crops has been extended to every conceivable land. The open grazing grounds in the plains have disappeared and forest areas in the hills have been badly mauled by excessive grazing. The legally notified forest area in the state is 2.82 lac ha which is about 5.6% of the total geographical area. However, more than half of the forest area is privately owned and is managed by the forest department mainly for the conservation of soil and moisture. The productive forest area in the state is thus extremely limited and does not exceed 1.1 lac ha.

The demand for wood

The expert committee on diversification of agriculture in Punjab (1986) has estimated the demand for wood by 2000 A.D. as follows :

(i)	Fuelwood	42 lac m^3
(ii)	Pulpwood	10 ” ”
(iii)	Small wood requirements for packing cases, wooden pallets and crates etc.	7 ” ”
(iv)	Timber for building construction, sports goods etc.	3 ” ”
	Total	62 lac m^3

The committee has estimated that about 3.3 lac ha of land will need to be planted with trees to meet the demand for fuelwood, small timber and pulpwood, Similarly, an area of 0.6 lac ha would have to be brought under timber species to meet the demand for timber for various uses. Thus a total land area of 3.9 lac ha would have to be planted with trees to meet the rural and industrial needs of the state.

As discussed above, the area under forests is very limited and it will not be possible to meet the demand for forest products from local sources. It may also not be possible to divert substantial agricultural lands to forestry even though the committee has recommended that 25-35% of the area under wheat-rice rotation should be diverted to other uses such as forestry, horticulture and dairying. The only other viable alternative therefore is to practise agro-forestry i.e. growing trees alongwith agricultural crops in a manner that the two are compatible and not competitive.

---

* Principal Chief Conservator of Forests, Punjab, Chandigarh.

**Conservator of Forests, Bist Circle, Punjab, Jalandhar.

During the last six years 22 crore plants mainly *Eucalyptus tereticornis* Smith (Syn. *Eucalyptus* hybrid) were supplied to the people by the Forest Department for planting on private lands. This species is also grown in Government forests. The Forest Department follows a rotation of 12-15 years while farmers generally harvest their trees after 8 years. The estimated availability of *Eucalyptus* wood by various log sizes in Punjab is given in Tables 1 and 2. The girth class in the tables are based on the findings of Kapur and Gupta (1986). These tables show that setting up of paper mills based on *Eucalyptus* is an urgent necessity if the farmer's interest in tree-farming is to be sustained.

Table 1

Estimated availability of Eucalyptus wood from Private Lands by log sizes

(Green weight in lac tonnes o.b.)

Year	Girth class (cm)				Total
	15-29	30-39	40-59	60 and above	
1986-87	0.52	1.30	2.00	0.03	3.85
1987-88	0.46	1.10	1.68	0.02	3.26
1988-89	0.63	1.53	2.30	0.03	3.49
1989-90	1.95	4.80	7.30	0.07	14.12
1990-91	4.20	10.20	16.58	0.16	30.14
1991-92	4.35	10.80	16.50	0.16	31.81
1992-93	3.30	8.05	12.35	0.13	23.83
1993-94	3.25	8.00	12.16	0.12	23.53

Source : Based on the surveys by the Forest Department and the Economic and Statistical Organisation, Punjab during 1982-83.

Table 2

Estimated availability of Eucalyptus wood from Government forests by log sizes
(Green weight in tonnes o.b.)

Year	Girth class (cm)					Total
	15-29	30-39	40-59	60-69	70 & above	
1986-87	3800	4300	9660	12000	18240	48000
1987-88	3800	4300	9660	12000	18240	48000
1988-89	3680	4140	9200	11500	17480	46000
1989-90	3683	4140	9200	11500	17480	46000
1990-91	2720	3060	6460	8500	12920	34000
1991-92	3680	4140	9200	11500	17480	46000
1992-93	13200	14850	31350	41250	62700	165000
1993-94	12320	13860	29260	38500	58520	154000

Source : Based on surveys by the Forest Department and the Economic and Statistical Organisation, Punjab, 1982-84.

Utilisation of *Eucalyptus* wood

Eucalyptus has established itself in the state as a timber species The main uses for *Eucalyptus* timber (girth 60 cm and above) are for dunnage pallets, rural roofing and packing cases. Other uses such as in house construction as scaffolding meterial, truck body building, door and window frames and furniture making have developed recently. The wood has been found suitable for making CWR grade plywood which is the most common grade manufactured in the country and a plywood mill based on *Eucalyptus* has started trial production in the state and is expected to utilize a considerable quantity of longer sized logs. Its suitability for higher grades is, however limited because of severe cross grain (Mathews *et al.*, 1986). The wood can also be used to manufacture fibre board and chip board.

Eucalyptus is a good fuelwood with a calorific value (4800 K cal/kg) very close to the important fuelwoods of Punjab (Kikar 4900 and Shisham 4900). However, the market for fuelwood (girth below 30 cm) is limited as most people resort to burning of cattle dung and agricultural wastes The absence of a paper/pulp mill based on wood (girth 30-59 cm) further limits the demand for small sized material. Therefore, one possible and promising use of small sized material could be in the manufacture of charcoal. Tests conducted by the State Forest Development Corporation show that a good quality charcoal can be obtained from *Eucalyptus.*

Management of *Eucalyptus* plantations

Eucalyptus is found to grow on practically all soils but does well on deep and lighter soils such as sandy loam and

Table 3

Growth data of some Eucalyptus plantations of Punjab raised under Social Forestry programmes.

Spacing (m×m)	Age (yrs.)	Av. dia (cm)	Quality of cultural operations	M.A.I. (m^3/ha)	Site type	Location
3.0×2.5	6.0	12.3	Good	18.04	Poor	V. Piareana
5.0×2.0	5.5	12.3	Average	13.50	Poor	Chak Sarkar RF
2.0×2.25	8.5	14.1	Average	15.57	Poor	V. Dhilwan Khurd
6.5×1.5	14.0	17.3	Average	22.80	Poor	R.F. Ludhiana
2.5×1.8	3.5	11.5	Poor	29.48	Poor	V Sodhiwala
1.7×1.7	8.0	12.4	Good	28.40	Poor	V. Behlewala
1.8×1.5	4.5	9.9	Average	18.54	Average	V. Malsian
3.0×3.0	20.5	35.2	Average	22.90	-do-	Bir Bhare Agol Patiala
3.0×4.0	14.0	27.6	Average	29.90	Poor	Govt. Forests Nasrala Hoshiarpur
4.0×4.0	3.0	12.7	Good	11.33	Good	V. Aima Mangat

Source : Dogra *et al.*, 1984.

sand. It grows better with some irrigation and fertilizer application, mainly nitrogenous. It is very important to keep weeds such as elephant grass, *Erianthus munja* and *Saccharum spontaneum* under control during the first 2-3 years of a plantation's life to ensure its establishment and good growth. The estimated yield from plantations raised on various sites and subject to variety of cultural treatment is given in Table 3 (above).

The table above shows that yield from *Eucalyptus* plantations in the state is quite high. This makes *Eucalyptus* farming a sound investment especially if trees are planted at a wider spacing and managed over a longer rotation of about 12 years. This is because as discussed above timber of 60 cm and above girth commands a good price. The prevailing log prices are given below :

Table 4

Price of Eucalyptus log by girth classes

Girth class (cm)	Price per m^3 (Rs.)
15 - 29	150
30 - 39	350
40 - 59	600
60 - 69	700
70 - 99	850
100 - 119	1050

The trend now is, therefore, towards wider spacing (8-10 m^2).

Present status of research in *Eucalyptus*

Systematic research on species and provenances of *Eucalyptus* was commenced in 1981 and about half a dozen trials were established between 1982 and 1983. The main species are *Eucalyptus tereticornis* and *Eucalyptus camaldulensis* Preliminary results show that several Australian provenances are growing better than the local *Eucalyptus* hybrid (Kapur and Dogra, 1987 a and 1987 c). It is hoped that final results of these trials would be available by the end of 1988. A spacing trial of *Eucalyptus* hybrid involving 14 spacings from 0.5 m × 0.5 m to 3.0 m × 3.0 m is also in progress. It has been observed that the highest total biomass 3 years after planting is given by the spacing 0.5 m × 1.0 m (48.11 O.D.T /ha) followed by 2.4 m × 1.0 m (40 83) and 1.0 m × 1.0 m (38.95). These spacings retain their ranking when their basal areas are compared. On the other hand the maximum mean diameter is given by the spacing of 3.0 m × 3.0 m (6.4 cm) while 3.0 m × 2.0 m is a close second with 6.2 cm. Data at age 4 has been collected and is being analysed (Kapur *et al.*, 1987).

Future research needs.

In Punjab, *Eucalyptus* hybrid has come to stay as the most important species for farm and agro-forestry. However, the timber is prone to end cracking and splitting on drying. Only a limited success could be achieved in preservative treatments with Ascu under pressure. It is, therefore, necessary to intensify research in evolving an efficient technique for seasoning and preservative treatment of the species to enable its wider use.

The presence of cross and wavy grain in the wood limits its use for higer grade plywood. It is, therefore, necessary to evolve suitable management practices to minimize this defect.

Yellowing of leaves has been observed in *Eucalyptus* plantations in the state which is more pronounced in coppice crops. Soil moisture-nutrient studies are suggested to understand the problem and evolve remedial measures.

It is also suggested that some well known timber species of *Eucalyptus* in Australia such as *E. grandis*, *E. regnans* and *E. delegatensis* be tried in view of the good fertility of Punjab soils and availability of irrigation. There is necessity to find suitable species for saline/alkaline areas of the state.

Poplars

During the recent past, farmers have shown interest in planting poplars in conjunction with agricultural crops. In 1986-87, more than 760 ha were planted with poplar. 1987-88 planting is likely to exceed 1200 ha and it is expected to cross 2000 ha in 1988-89. The spacing commonly adopted is 5.0 m × 4.0 m. Common agricultural crops are berseem, wheat, pulses, sugarcane and vegetables. Turmeric can be grown under shade. Most plantations are growing well and the rotation is expected to be 8-10 years. At present only the G-3 clone of *Populus deltoides* is being planted but research is being undertaken to test the suitability of other clones for Punjab conditions.

Growth data have been collected for two plantations of poplars in the state and are given in Table 5 for the sake of illustration.

Table 5

Clone	Age (yrs)	Spacing (m × m)	Mean dia (cm)	Mean height (m)	Mean Vol. per tree (m^3)	M.A I m^3/ha
G - 3	2 5	4 0	7 93	9 97	0 02326	Line planting
G - 3	8.75	3.0 × 3.0	23.11	23 44	0 45483	46.92

The volume per tree has been estimated with the help of regression equation supplied by Chaturvedi (1983) and M.A.I. after Singh and Mittal (1983). The above data though only representative clearly show that poplar is doing well in the state and compares favourably with the best plantations in the Terai region raised under irrigated conditions.

The use of poplar wood for the manufacture of plywood and match splints is well established in the country. It is necessary to develop its use for the manufacture of sports goods and furniture. In North India, softwoods such as deodar, pines, fir and spruce are normally used for making cupboard shelves and panels etc. With the moratorium on felling of green trees above 1000 m altitude, the availability of softwoods is declining. There is a necessity to develop the use of poplar for these purposes also.

Leaf defoliators, Ganoderma root rot and foliage rusts are the common pests of poplars in the state. Dependence on one clone is, therefore, unwise. Research is needed to develop hybrids and clones which are disease resistant and suitable for varied climatic and edaphic conditions In particular, suitable clones need to be developed for poorly drained and saline/alkaline soils. Research is also needed to evolve an efficient package of tending operations such as irrigation, fertilizers and pruning. In addition, growth and yield studies need to be undertaken for the agro-forestry plantations in the state.

Other species

However, dependence on one or two species is not desirable in the long run. Semul (*Bombax ceiba*), Drek (*Melia azedarach*) and Siris (*Albizia lebbeck*) are the indigenous fast growing species which need to be tried. These species have been planted sporadically but have not been tried on an extensive scale. Semul is particularly useful for planting in the sub-montane region of the state known as Kandi area. Both Drek and Siris can be harvested after 15-18 years and yield timber of acceptable quality.

The soils of Punjab are quite fertile. With availability of irrigation and the farmer's zeal to grow trees as a crop, it should not be difficult to grow tropical pines for timber. It is, therefore, felt that research on the above indigenous species and *Ailanthus*, *Gmelina* etc. needs to be intensified in the state.

Su-babul (*Leucaena leucocephala*) has

also been tried in the state. It grows quite well but has not been popular with the farmers because they are able to grow better fodder crops such as Egyptian clover, lucerne, maize and oats. It is not a good fuel and as stated above the market for fuelwood in the state is limited.

SUMMARY

In Punjab, the area under forests is extremely inadequate for meeting the requirement of the people for fuelwood and timber for individual needs The State Government has, therefore, encouraged farm and agro-forestry to increase wood production. *Eucalyptus tereticornis* has established itself as a timber species in the state. Poplar is another species which has found favour with the progressive farmers. The Punjab farmers have shown great zeal in raising tree crops. In order to sustain the interest in tree farming, it is necessary to set up wood-based industries which will in turn contribute significantly to the economic development of the state.

At the same time, it is desirable to try indigenous species also so that undue dependence on the above species is avoided in the long term interest of environmental preservation. Research is therefore required in this direction urgently alongwith research on the production and utilization aspects of the established species.

पंजाब की ग्रामीण व औद्योगिक आवश्यकताए पूरी करने के लिए उपयोगी शीघ्रवर्धी वृक्ष जातियां वर्तमान स्थिति तथा भविष्य मे अनुसन्धान की आवश्यकताएँ

एस० के० कपूर व ए० एस० डोगरा

सारांश

पंजाब में लोगों की ईंधन काष्ठ और प्रकाष्ठ की अपनी आवश्यकताएं पूरी करने के लिए वन का क्षेत्र अत्यधिक अपर्याप्त मात्रा में है। इसलिए यहां की राज्य सरकार ने काष्ठ उत्पादन बढ़ाने के लिए बड़े क्षेत्रों और कृषि-वानिकी को प्रोत्साहित किया है । इस राज्य में युकेलिप्टस टेरेटिकार्निस प्रकाष्ठ जाति के रूप में स्थापित हो चुका है। दूसरी वृक्ष जाति पोपलर है जिसे प्रगतिशील किसानों ने बहुत पसन्द किया है। पंजाब के किसानों ने वृक्षों की फसल उगाने में बहुत उत्साह दिखाया है। वृक्षोत्पादन मे उनकी रुची बनाए रखने के लिए जरूरी है कि वहाँ काष्ठाधारित उद्योग खड़े किये जाए जो आगे चलकर राज्य के आर्थिक विकास में भी सार्थक योगदान करेंगी।

इसके साथ-साथ देसी वृक्ष जातियो को लगाकर देखना भी वांछनीय है ताकि उपर्युक्त वृक्ष जातियों पर अनावश्यक आश्रिता से बचा जा सके जो पर्यावरण सरक्षण के दूरगामी हित में भी होगा। अत : स्थापित वृक्ष जातियों के उत्पादन और उपयोजन पर अनुसन्धान करने के साथ-साथ इस दिशा में जल्दी से अनुसन्धान कार्य आरम्भ कराने की आवश्यकता है।

References

Chaturvedi, A.N. (1983). Poplars for farm forestry in Uttar Pradesh. *Indian For.*, **109** (9) : 661-64.

Dogra, A.S., P.L. Kaler, and Swarn Singh (1984). *Report of the Eucalyptus Survey Committee in the State of Punjab* (Un-published)

Johl, S S. (1986). Report of the expert committee on diversification of agriculture in Punjab.

Kapur, S.K. and A.S. Dogra (1987 a). Provenance trial of *Eucalyptus tereticornis* in Punjab. *Indian For.*, **113** (1) : 2-5.

.... (1987 b). Species-cum-provenance trial of *Eucalyptus* in Punjab. *Indian For.*, **113** (4) : 238-41.

.... (1987 c). Provenance trial of *Eucalyptus camaldulensis* in Punjab. *Indian For.*, **113** (7) : 471-75.

Kapur, S.K., A.S. Dogra, and M.P. Rai (1986). Current trends in the management of *Eucalyptus* plantations in Punjab. Submitted for the 3rd Forestry Conference, F.R.I , Dehra Dun.

.... (1987). Biomass production and economics of *Eucalyptus* in Punjab Submitted to Seminar on *Eucalyptus* at the F.R I., Dehra Dun.

Kapur, S.K. and B.N. Gupta (1986). Recovery of scantlings from *Eucalyptus* logs. *Indian For.*, **112** (6) : 491-502.

Mathews, K.C.; T.S. Rangarajin, K. Shyamasunder and H.N. Jagdeesh (1986). Investigation on the suitability of plantation grown *Eucalyptus tereticornis* from Punjab for manufacture of plywood. Indian Plywood Industries Research Institute, Bangalore. *IPIRI Research Report No. 15.*

Singh, S.P. and M.C. Mittal (1983). Growth of poplar plantations in Terai Region of Uttar Pradesh *Indian For.*, **119** (10) : 755-61.

STUDIES ON THE PERFORMANCE OF PHILLIPINES AND MALAYSIAN PROVENANCES OF *ALBIZIA FALCATARIA* (L.) FORBERG AT NURSERY STAGE UNDER NORTH INDIAN MOIST TROPICAL CONDITION

V.K. BAHUGUNA, K.P. UNNIKRISHNAN* AND U.C. DHAUNDIYAL

Directorate of Silviculture Research,
Forest Research Institute, Dehra Dun (*India*)

Introduction

Albizia falcataria (L.) Forberg, belongs to the family Mimosoideae. It is one of the fastest growing broad leaved species and is rapidly becoming popular in India. It has been extensively planted in tropical regions including Phillipines, Sri Lanka, Indonesia etc. In India the tree has been planted on an experimental basis in Assam, Kerala, Tamil Nadu, Tripura and Andamans. It is an excellent shade tree for coffee and tea gardens. It grows successfully in areas having more than 2250 mm rainfall. In Nigeria with an annual rainfall of 1500 mm, it attained a height of 9.75 m in 4 years (Smith). However, in areas having four driest months, it does not grow well. The species does not prefer any specific soil, and is, therefore, not exacting for its soil needs. The species can be planted upto an altitude of 1350 m.

The tree is a strong light demander, and does not like shade. It has shallow but extensive root system. In India the species attained an average height of 9.9 m and a girth of 45 cm in 6 years in Tamil Nadu. In Dehra Dun the seedlings growing in the nursery attained an average height of more than 3 m in one year.

The species grows comfortably in the nursery. On account of easy handling during nursery stages and its potential growth, the species can be a potential substitue to Eucalypts in areas, where the rainfall is quite good. The species has the added advantage of enriching the soil and hence is of potential importance for social forestry plantations.

The present investigation was therefore, taken up to develop its nursery technique and to evaluate the relative performance of Phillipines and Malaysian seed origin, under Dehra Dun conditions.

Material and Method

Seeds of *Albizia falcataria*, were procured from Malaysia and Phillipines. The seeds were soaked in tap-water at room temperature for 12 hours before sowing. Keeping in view the above objectives a split plot design was used for testing the performance of each seed origin. There were 6 main treatments (soil media) and 3 sub-treatments (sowing depths). The main treatments and sub-treatments were duly

---

*Presently Dy. Director, National Income Division, C.S.O., New Delhi.

Table

Table giving the mean values, bar-diagrams along with their significance for the

Source	Malaysia								
Treatments	S			T					
Characters		N.S.				N.S.			
	S_1	S_2	S_3	T_1	T_2	T_3	T_4	T_5	T_6
Mean daily germination in percentage	1.79	2.08	2.15	2.09	2.01	2.04	2.07	2.03	1.79
		N.S.				N.S.			
	S_1	S_2	S_3	T_1	T_2	T_3	T_4	T_5	T_6
Germination value	4.205	5.669	5.871	5.539	5.131	4.925	5.979	5.302	4.616
		N.S.				N.S.			
	S_1	S_2	S_3	T_1	T_2	T_3	T_4	T_5	T_6
Average height (cms)	20.647	18.714	18.918	19.733	20.828	17.063	18.223	21.585	19.129
		N.S.				N.S.			
	S_1	S_2	S_3	T_1	T_2	T_3	T_4	T_5	T_6
Average diameters (cms)	0.222	0.203	0.206	0.213	0.224	0.193	0.201	0.230	0.201
		N.S.				N.S.			
	S_1	S_2	S_3	T_1	T_2	T_3	T_4	T_5	T_6
Survival percentage on the basis of germination.	46.43	47.71	46.08	50.63	49.34	43.81	42.20	52.24	42.23

1

treatments S and T under the Sources Malaysia and Phillipines separately

	Phillipines									
S×T	S			T						S×T
		xxx					N.S.			
	S_2	S_3	S_1	T_1	T_2	T_3	T_4	T_5	T_6	NS
NS	2.22	1.98	1.74	1.98	2.03	2.17	1.90	2.00	1.78	
		xx					N.S.			
	S_2	S_3	S_1	T_1	T_2	T_3	T_4	T_5	T_6	NS
NS	5.743	4.530	3.826	4.612	4.557	5.486	4.599	5.053	3.891	
		N S.				xx				
	S_1	S_2	S_3	T_5	T_2	T_1	T_6	T_3	T_4	NS
NS	22.926	21.843	19.328	23.843	22.656	22.510	22.381	18.861	17.943	
		N.S.					N.S.			
	S_1	S_2	S_3	T_1	T_2	T_3	T_4	T_5	T_6	NS
NS	0.236	0.231	0.217	0.240	0.242	0.202	0.209	0.244	0.233	
		N.S.					N.S.			
	S_1	S_2	S_3	T_1	T_2	T_3	T_4	T_5	T_6	NS
NS	45.58	43.77	49.93	50.73	46.08	38.70	43.96	53.68	45.43	

xx Indicate significant at 1 per cent level of probability.
xxx Indicate significant at 0.1 per cent level of probability.
NS Not significant even at 5 per cent level of probability.

Table 2

Table giving the mean values and necessary bar-diagrams for treatments, depths of sowing and sources along with their interactions significance for pooled data under M and P

Characters		Treatments (soil media) T						Depths of sowing S			Sources		
Mean daily germination in percentage				N.S.				xx				N.S.	
	Mean germination	T_1	T_2	T_3	T_4	T_5	T_6	S_2	S_3	S_1	M		P
		2.03	2.02	2.11	1.09	2.02	1.78	2.15	2.06	1.76	2.01		1.98
Germination value				N.S.				xx				N.S.	
		T_1	T_2	T_3	T_4	T_5	T_6	S_2	S_3	S_1	M		P
		5.075	4.844	5.205	5.289	5.178	4.253	5.706	5.200	4.016	5.249		4.700
Average height cms.								N.S.				x	
		T_1	T_2	T_3	T_4	T_5	$T_6$5	S_1	S_2	S_3	P	>	M
		21.121	21.742	17.962	18.083	22.714	20.75	21.786	20.279	19.123	21.365		19.427
Average diameter cms.								N.S.				x	
		T_1	T_2	T_3	T_4	T_5	T_6	S_1	S_2	S_3	P	>	M
		0.226	0.233	0.197	0.205	0.237	0.217	0.229	0.217	0.211	0 228		0.210
Survival percentage on basis of germination								N.S.				N.S.	
	Mean survival %	T_1	T_2	T_3	T_4	T_5	T_6	S_1	S_2	S_3	M		P
		50.68	47.71	41.25	43.25	52.96	43.83	46.01	43.74	48.01	46.74		46.43

N.S. = Indicates not significant. x = Indicates significant at 3 per cent. xx = Indicates significant at 1 per cent.
xxx = Indicates significant at 0.1 per cent.

randomised at the time of lay out. The main plots were of size 1 m × 10 m and the sub-plots were of size 90 cm × 45 cm. Sufficient space was left in between the experimental plots to avoid competition. The details of the treatments are given below.

Main treatments

T_1 =	Soil, Sand, FYM	(2 : 1 : 1)
T_2 =	Soil, Sand, FYM	(1 : 1 : 1)
T_3 =	Soil, Sand	(2 : 1)
T_4 =	Soil, Sand	(1 : 1)
T_5 =	Soil, Sand, Pit compost	(2 : 1 : 1)
T_6 =	Soil, Sand, Pit compost	(1 : 1 : 1)

Sub-treatments

S_1 =	Depth of sowing	0.5 cm
S_2 =	Depth of sowing	1.0 cm
S_3 =	Depth of sowing	1.5 cm

Preparation of soil media : Soil media were prepared with forest soil collected from adjoining Chir forests, river sand collected from Yamuna river, Farm yard manure locally collected from cowshed and pit compost prepared from tree-leaves and seed husk. All these were separately sieved and the mixtures prepared separately according to the prescribed treatments. The mixtures were spread over the beds having 15 cm thickness.

Seed sowing : Two hundred sound seeds were sown through broadcasting on 17th May, 1986 under each treatment. According to the prescribed sub-treatments (S) the some soil media were spread over the sown seeds so that the depth may be 0.5 cm, 1.0 cm and 1.5 cm. For this soil quantity 2025 C.C. (S_1) 4050 C.C. (for S_2) and 6075 C.C. (for S_3) were equally spread over the seeds.

After sowing thorough watering was done with fine rose can. Watering was done twice a day except on rainy days. Hand weeding was also done when required and the beds were kept free from weeds.

Observations : Daily germination and mortality of seedlings were recorded. After completion of germination height and diameter (at collar region) were recorded during the last week of August 1986.

Results and Discussion

The data, so obtained were put to statistical analysis, to see, whether any significant difference exists in the effect of soil media, depth of sowing etc. on each of the character studied separately for the two different seed origins Statistical analysis shows that, the soil media do not differ significantly in their effect on any character except on average height for Phillipines seed origin. The depth of sowing, on the other hand exhibited significant difference in their effect on mean daily germination percentage and on germination value, in case of Phillipines provenance, as well as pooled data for both the provenances.

There are significant differences in average height and average diameter among the two provenances. The results of the analysis are given in the attached Tables 1 and 2. The treatments under the same bar do not differ significantly among themselves in their effect and are in the same group.

It is evident from the Table 1 that the main treatments, sub-treatments and their interactions were not significantly different for the characters studied viz. Mean daily germination, Germination value, Average height, Average diameter and Survival per cent, for the seeds of Malaysian provenance. It shows, that all the treatments are equally effective, and no preference can be given to any treatment. However, in case of seeds of Phillipines origin, depth of sowing had significant difference on mean daily germination and germination value. The best depth of sowing on the basis of results recommended is 1 cm i.e. S_2. The treatments are not significantly different for the remaining characters The soil media had greater impact on average height of the plants in Phillipines provenance, as the results are significantly different among the various treatments. Treatments T_1, T_2, T_5 and T_6 have given best results. However, treatment T_5 or T_1 may be prefered over others. The effect of treatments on average diameter and survival however, in this case are equal and are not significantly different.

It is evident from Table 2 that in the pooled data also the treatment S_2 (depth of sowing 1 cm), proved best as S_2 and S_3 are significantly different from S_1 (depth of sowing 0 5 cm). The results further indicate that Phillipines provenance gave better performance in average height and average diameter growth, thus conclusively proving that Phillipines provenances are better than the Malaysian for introduction under Dehra Dun climatic condition.

On the basis of investigation carried out, it is advisable that, in the Dehra Dun, agroclimatic zone, *Albizia falcataria* provenance of Malaysian origin may be prefered, for planting and the seeds should be raised in the soil media, where the ratio of soil, sand and manure is 2 : 1 : 1. The depth of sowing should be 1 to 1 5 cm. The results of this experiment were further corroborated by the fact that after examination of the seedling in the nursery after one year, the seedling of Phillipines provenance had acquired much more height than the seedling of Malaysian provenance.

Acknowledgement

We are thankful to Shri Ramswaroop, Research Assistant II, Silviculture Branch for the help rendered.

SUMMARY

***Albizia falcataria* (L.) Forberg is one of the most fast growing species. It makes few demands on the soil and hence is suitable for rapid afforestation of poor soil. On account of its wide adaptability, the species promises to be one of the excellent planting materials for social forestry and wasteland afforestation programmes, particularly in areas where the rainfall is good. The paper deals with the results of an experiment, carried out on its nursery technique and choice of better provenance under Dehra Dun conditions.**

एल्बीजिया फाल्केटेरिया (लि०) फॉरबर्ग के फिलीपाइनी और मलेसियाई स्थान-विभेदों की उत्तर भारत की आर्द्र उष्ण अवस्थाओं मे रोपणी स्तर पर क्रियाशीलता का अध्ययन

वी०के० बहुगुणा, के०पी० उन्नीकृष्णन व यू०सी० ढौंडियाल

सारांश

एल्बीजिया फाल्केटेरिया (लि०) फॉरबर्ग बहुत तेज बढ़ने वाली वृक्ष जातियों में से है। मृदा से इसकी अपेक्षाएं कम ही हैं और इसलिए घटिया भूमियों का तेजी से वनीकरण करने के लिए यह उपयुक्त है। सुदूर तक अनुकूल बन सकने के कारण समाज बानिकी और बंजर भूमि के वनीकरण कार्यक्रमों, विशेषकर ऐसे क्षेत्रों में जहां वर्षा कम होती है, वृक्ष लगाने की वस्तुओं मे इसके अत्युत्तम रहने की सभावना है। प्रस्तुत अभिपत्र में उस संपरीक्षण के परिणाम दिए गए हैं जो देहरादून जैसी दशाओं में इस वृक्षजाति की रोपण विधि और इसका श्रेष्ठतर स्थान-विभेद चुनने के लिए किया गया था।

Reference

Troup, R.S. (1921). *Silviculture of Indian Trees* (Revised 1983) Vol. IV.

OBSERVATIONS ON FLOWERING, FRUITING AND GERMINATION BEHAVIOURS OF SOME USEFUL FOREST PLANTS OF ARUNACHAL PRADESH

B.S. BENIWAL* AND N.B. SINGH**

Introduction

Arunachal Pradesh is known for its rich flora There are about 3,000 species of flowering plants in Arunachal Pradesh out of which about 700 species are of economic importance Not much published literature about flowering, fruiting and germination of commercially important forest plants of Arunachal Pradesh is available. Efforts have been made to find out the above information for some species and reproduce in a tabular form.

This article includes information about indigenous and some exotic forest plants tried in Arunachal Pradesh. Most of the information have been collected by the authors from the observations and trials conducted during the period from 1978 to 1986 and some observations made later on.

Following information have been included in Table 1 :

1. *Flowering* : Maximum flowering period has been mentioned.

2. *Fruiting* : The beginning of ripening of fruits to maximum fruit ripening period has been mentioned. Fruits will also be available beyond this period but quality and quantity will not be available.

3. *Weight of seed/fruit* : Weight of dry seed/fruit have been taken Seed means fruit dried after removal of pulp and the fruit means whole fruit dried with pulp.

4. *Commencement and completion of germination from sowing date* : The period has been counted from the date of sowing of seed. In some species viz. *Acrocarpus fraxinifolius*, *Canarium strictum*, *Juglans regia* and *Tectona grandis* though maximum seed germinates within 60-90 days but completion of germination takes even more than one year, but number of such seed which takes more than one year to germinate are very negligible.

5. *Germination percentage* : Germination percentage means the percentage of number of seeds in a given sample that actually germinate within a given period. Though there will be difference of germination percentage between laboratory and nursery condition, but this difference is not much for medium and big sized seeds but in case of minute seed of species like *Duabanga grandiflora*, *Tetrameles nudiflora*, *Anthocephalus chinensis*, the difference is much and

---

* Asstt. Silviculturist (G), Forest Research Institute, Dehra Dun.

** Scientist (Forestry), H.R.R.S., Sharbo, Kinnaur (H.P.)

the germination percentage of these species under nursery condition vary from 0.5 to 6% whereas, under laboratory condition, germination pecentage is more than 60%.

Germination studies of seeds of subtropical and temperate species were carried out in the same altitudinal zone at Dirang and Towang research centres and for other species, it was conducted at Chessa Centre (200 m elevation). Sand was used as germination media for small and big seeds whereas, germination paper was used for *Adina cordifolia*, *Alnus nepalensis*, *Altingia excelsa*, *Anthocephalus chinensis*, *Betula alnoides B. cylindrostachys*, *Callistemon vimanalis*, *Duabanga grandiflora*, *Exbucklandia populnea*, *Eucalyptus* spp., *Grevillea robusta*, *Morus laevigata*, *Populus* spp., and *Tetrameles nudiflora*. Germination for all the species was carried out at room temperature, moisture was controlled by keeping water in extra trays Water was given to the perforated germination trays as and when required by dipping lower perforated portion of the trays. In case of germination paper, a part of the paper was dipped in the water tray for keeping optimum moisture.

6. *Viability period* : Viability or the germination capacity has been taken for the seed (fruit) stored in dry container under room temperature. It is the period during which seed (fruit) has potential capacity to germinate.

7. *Number of seed/fruit in 1 kg* : Seeds/fruits of most of the species were dried in the sun and weight was taken but in case of seed which gets spoiled if dried in the sun, weight of fresh seed/fruits or slightly dried under the shade was taken. These species are : *Aquilaria agallocha*, *Amoora wallichii*, *Cinnamomum cecidodaphne*, *Dipetrocarpus Macrocarpus*, *Machilus globosa*, *Madhuca butyracea*, *Magnolia globosa*, *Manglietia caveana*, *M. insignis*, *Michelia champaca*, *M. doltsopa*, *M. montana*, *Parkia roxburghii*, *Phoebe goalparensis*, *P. cooperiana*, *Polyalthia jenkinsii*, *Pterygota alata*, *Shorea assamica*, *S. robusta*, *Sterculia villosa*, *Syzygium jambolana*, *Talauma phellocarpa*.

8. *Plant per cent* : It is the percentage of the number of seeds in a sample that grow into seedlings at the end of the first growing season. This is more important and is more realistic compared to germination percentage. Plant per cent gives correct figure about the number of seedlings that one can expect from a given number of seeds. This data is more important for raising field nurseries to meet the requirement of seedlings for raising plantations. While germination percentage of most of the species are very high under laboratory condition, plant per cent of most of the species are very low.

9. *Seedlings obtained from 1 kg seeds/fruits* : Figures in this column have been worked out from plant per cent.

Table 1

Species	Local name	Flowering time	Fruiting time	Commencement & completion of germination (in days) from sowing date	Germination per cent	Viability period (days)	Number		Plant per cent	Seedlings obtained from 1 kg seed/fruit
							Seeds per kg	Fruits per kg		
1	2	3	4	5	6	7	8	9	10	11
Abies densa	Fir	March	2w Oct- 2w Nov	30-60	65	180	17,200	—	15	2,580
A. spectabilis	,,	,,	-do-	—	70	180	20,500	—	15	3,075
Acacia catechu	Khair	July	4w Dec- 3w Jan	4-40	85	270	38,000	—	30	11,400
Acer campbellii	Maple	May	1w Oct- 2w Nov	25-60	42	180	—	31,000 (single (carpel)	25	7,750
A. oblongum	,,	May	-do-	—	50	180	—	20,500 (single carpel)	20	4,100
Aquilaria agallocha	Agar	April	2w June- 2w July	9-52	62	60	15,150	—	40	6,060
Acrocarpus fraxinifolius	Mandani	Feb	2w Apr- 2w May	6-500	40	800	29,300	—	35	10,255
Adina cordifolia	Haldu	Oct	1w Dec- 4w Jan	6-155	50	350	1,12,85,000	—	08	90,280
Aegle marmelos	Bel	Nov-Dec	2w March-May	13-65	35	120	5,300	—	21	1,113
Ailanthus excelsa	Maharukh	March	2w June- 1w July	18-45	36	240	9,500	—	15	1,425
A. integrifolia	Borpat	Aug	1w Dec- 1w Feb	25·120	85	210	1,720	—	62	1,066

(*Contd...*)

1	2	3	4	5	6	7	8	9	10	11
Albizia arunachalensis		May	2w Sep- 2w Oct	6-10	43	730	50,900	—	32	16,288
A. chinensis		May	4w Nov- 4w Dec	4-10	70	365	42,000	—	40	16,800
A. falcataria		May	Oct-Dec	4-10	75	380	42,000	—	30	12,600
A. lebbek	Koroi	May	2w Nov- 4w Dec	5-10	60	2,190	9,200	—	40	3,680
A. lucidior	Moj	June	2w Mar- 2w April	4-25	75	180	9,200	—	35	3,150
A. procera	Siris	Aug	2w Feb- 2w Mar	5-10	70	3,650	20,000	—	50	10,000
Alnus nepalensis	Alder	Aug	2w Nov- 2w Dec	8-36	60	120	23,00,000	—	5	1,15,000
Alstonia scholaris	Satiana	Sept	4w Mar- 2w Apr	5-25	40	60	6,69,100	—	10	66,910
Altingia excelsa	Jutuli	Feb	1w Nov- 2w Dec	10-70	39	180	8,00,000	240	15	1,20,000
Amoora wallichii	Amari	July	2w June- 2w July	10-55	22	60	230	70	10	23
Anacardium occidentale	Cashew-nut	Mar	3w June- 2w July	12-92	80	230	180	—	50	90
Anthocephalus chinensis	Kadam	June	2w Aug- 4w Nov	8-180	90	365	20,00,000	—	1	20,000
Artocarpus chaplasha	Sam	Mar	3w June- 2w July	6-21	62	25	1,230	—	52	640
A. integrifolia	Kathal	Mar	2w June- 2w July	6-30	70	45	58	—	65	38
A. lakoocha	Dewachali	Mar	4w June- 3w July	6-21	65	25	2,820	—	50	1 410
Azadirachta indica	Neem	April	1w June- 2w July	7-10	55	30	4,000	1750	35	1,400

(*Contd...*)

1	2	3	4	5	6	7	8	9	10	11
Bauhinia purpuria	Kanchan	Feb & Nov	April-July	9-30	87	365	4,250	—	80	3,400
B. variegata	Boga Kanchan	Oct	2w Mar- 1w May	9-30	90	1,095	3,600	—	80	2,880
Bambusa tulda	Jati bamboo	Feb	April-May	9-30	92	365	25,600	—	30	7,680
Betula alnoides	Bhojpatra	Mar	2w May- 4w June	12-35	60	120	1,38,00,000	—	0.4	55,200
B. cylinrostachys	Birch	Mar	3w May- 4w June	12-112	40	120	1,40,00,000	—	0.4	56,000
Bischofia javanica	Urium	April	3w Dec- 4w Jan	12-26	75	365	1,05,000	—	30	31,500
Bombax ceiba	Simul	Feb	4w Mar- 2w Apr	4-28	46	365	43,000	—	25	10,750
Bridelia retusa	Kuhir	Sept	2w Dec- 3w Jan	34-60	19	180	—	8,240	25	2,060
Butea monosperma	Palas	Feb	2w June- 2w July	5-32	82	280	1,180	—	40	472
Calamus tenuis	Jati bet	April	June	70-120	30	180	5 100	—	25	1,275
C. floribundus	Lejai bet	April	June	70-120	35	180	2,400	—	25	600
C. erectus	Jeng bet	April	June	80-140	40	180	220	250	28	62
C. flagellum	Raidang bet	April	Jan	100-180	53	180	220	—	46	101
C. latifolius	Houka bet	April	Jan	120-183	15	180	210	—	12	25
Callistemon vimanalis	Bottle brush	Feb & July	May & Oct	15-56	30	365	2,50,000	—	15	1,27,500
Canarium strictum	Dhuna	June	2w Dec 4w Jan	26-140	90	545	300	—	70	210
Cassia fistula	Sonaru	June	1w Jan- 4w March	5-73	65	4,500	6,800	—	56	3,808

(*Contd* ..)

1	2	3	4	5	6	7	8	9	10	11
C. nodusa	—	June	Jan-March	5-42	52	1,095	8,000	—	45	3,600
C. siamea	—	July	May-June	5-40	55	1,095	35,000	—	38	13,300
Castanopsis indica	Hingori	Oct	2w Oct- 2w Nov	35-50	45	180	1,300	—	18	234
Casuarina equisetifolia	Sura	Sept & Feb	Dec & June	5-45	20	180	7,50,000	—	5	37,500
Cedrus deodara	Deodar	June	Oct & Nov	25-62	70	120	8,000	—	35	2,800
Cephalostachyum capitatum	—	March	July	31-90	25	180	1,885	—	12	226
Cephalataxus griffithii	—	Feb	4w Nov- 2w Jan	42-95	15	120	12,800	—	5	640
Cinnamomum camphora	Kapur	Feb	Sept-Oct	35-75	55	180	—	7,000	40	2,800
C. cecidodaphne	Gonsoroi	Feb	2w Sept- 2w Oct	24-49	45	45	1,250	220	15	188
Chukrasia velutina	Bogipoma	May-	2w Jan- 2w Feb	6-36	88	180	90,000	50	35	31,500
Cryptomeria japonica	—	May-June	Sept-Oct	21-33	80	150	3,00 000	1,00,00	12	36,000
Cupressus torulosa	Dhupi	March	2w Sep- 3w Nov	22-55	55	545	2,40,000	—	13	43,200
Dalbergia assamica	Mouhit	May	2w Nov- 2w Dec	7-32	85	365	92,500	—	22	20.350
D. latifolia	Rosewood	Feb	4w Nov- 2w Jan	5-25	80	240	28,000	—	35	9,800
D. sissoo	Sissoo	March	2w Nov- 2w Dec	7-34	85	365	55,000	—	42	23,100
Dendrocalamus strictus	—	Feb	June-July	8-26	75	730	32,000	—	60	19,200
D. giganteus	Tabou	Feb	May-June	10-30	70	365	17,000	—	55	12,050

(*Contd...*)

1	2	3	4	5	6	7	8	9	10	11
D. hamiltonii	Kake bamboo	Feb	April-	8-28	68	530	38,500	—	35	22,900
D. sikkimensis	—	Feb	April	9-31	55	380	16,700	—	62	11,100
Delonix regia	Gulmohar	June	4w Jan-Mar	6-31	85	730	1,850	—	68	1,258
Diospyros melanoxylon	Tendu	Feb	May-June	7-25	65	365	1,100	—	52	572
Dipterocarpus macrocarpus	Hollong	Sept	4w Feb- 4w March	8-21	70	45	—	64	56	36
Dubanga grandiflora	Khokon	Feb	2w April- 2w May	6-40	70	240	5,40,00,000	—	0.5	2,70,000
Elaeocarpus aristatus	Gahori-sopa	Feb	4w Aug- 3w Sept	27-60	35	120	500	—	28	140
E. floribundus	Jalpai	Feb	4w Dec- 4w Jan	30-76	42	90	500	—	30	150
E. sphaericus	Rudr-akash	Feb	3w Sep- 3w Oct	32-120	10	—	430	—	4	17
Ecucalyptus camaldulensis	—		Dec- Jan	5-30	80	730	30,00,000	—	8	2,40,000
E. citriodora	—	July	Dec - Jan	5-30	80	730	2,00,000	—	15	30,000
E. globulus	Bluegum	Dec-Jan	Feb-April	15-35	85	800	3,50,000	—	10	35,000
E. grandis	—	Dec	Feb-Mar	5-30	85	730	30,00,000	—	6	1,80,000
E. torellianu	—	Sept	1w Mar 1w Apr	8-25	75	730	5,30,000	—	4	21,200
E. robusta	Swamp-Mahogany	Oct	Feb-Mar	5-25	84	730	4,20,000	—	11	46,200
Exbucklandia populnea	Pipli	Feb & Nov	Mar & Dec	10-28	65	400	2,74,000	—	12	32,880
Gmelina arborea	Gamari	March	2w May- 1w June	7-30	65	180	2,500	90	38	950
Grevillea robusta	Silver Oak	March	4w May- 2w June	15-48	60	240	1,00,000	—	5	5,000

(*Contd* ..)

1	2	3	4	5	6	7	8	9	10	11
Havea brasilensis	Rubber	March	4w Sep- 1w Oct	5-25	75	28	—	—	—	—
Jacaranda acutifolia	Jacranda	April	Dec	6-18	50	365	50,000	—	30	15,000
Juglans regia	Walnut	May	3w Sep- 2w Oct	28-95	65	365	60	—	56	34
Juniperus recurva	—	April	4w Aug- 4w Sept	25-62	50	730	3,600	—	33	1,188
Kydia glabrescens	Pichola	Sept	2w Dec- 3w Jan	6-78	35	150	2,20,000	—	15	33,000
Lagertroemia parviflora	Sida	May	3w Nov- 2w Dec	10-62	40	1,095	28,000	—	12	3,360
L. speciosa	Ajar	April	1w Nov- 3w Dec	6-58	45	1,095	1,10,000	—	18	19,800
Larix griffithii	Larch	June	2w Oct- 1w Nov	30-75	55	150	1,00,000	—	8	8,000
Lannea coromandelica	Jiapoma	March	2w May- 2w June	10-35	41	120	8,000	—	20	1,600
Machilus globosa	Kawla	June	2w Feb- 4w Mar	21-80	40	180	2,500	—	30	750
Madhuca butyracea	Pinshing	Jan	2w June- 2w July	10-36	70	30	1,030	—	50	515
Livistonia jenkensii	Tokopat	Feb-Mar	July-Aug	44-120	30	90	230	—	25	57
Magnolia globosa	—	May	2w Oct- 2w Nov	30-65	20	60	3,500	—	10	350
Manglietia caveana	Phulsopa	May	3w Aug- 4w Sept	28-43	25	35	—	—	—	—
M. insignis	—	May	2w Aug- 4w Sept	26-48	25	35	10,480	5	15	1,572
M. azedarach	Ghoraneem	April	1w Oct- 4w Nov	32-86	80	365	—	850	60	510

(Contd..)

1	2	3	4	5	6	7	8	9	10	11
Mesua ferrea	Nahar	April	2w Aug- 2w Sept	8-95	40	150	230	—	30	69
Michelia champaca	Tita-champa	May	1w Aug- 2w Sept	25-55	30	21	10,000	—	16	1,600
M. doltsopa (M. excelsa	—	May	1w Aug- 2w Sept	25-50	40	60	11,500	—	15	1,725
M. montana	Pansopa	May	1w Aug- 1w Sept	23-50	30	21	14,000	—	15	2,100
Mimusops elengi	Dukul	Nov-Dec	3w Feb- 2w March	15-44	70	150	4,000	—	50	2,000
Morus laevigata	Bola	Feb	4w March- 2w April	20-85	10	180	3,50,000	—	6	21,000
Nyssa sessiliflora	Gahorisopa	—	—	29-190	35	90	14,000	—	—	—
Parkia roxburghii	Manipuri urohi	Sept	2w March- 3w April	5-15	80	90	945	—	60	567
Phosbe cooperiana	Mekahi	April	1w Oct- 1w Nov	25-90	50	150	140	70	35	49
P. goalparensis	Bonsum	April	1w Oct- 1w Nov	35-120	40	150	710	—	30	213
Phyllanthus emblica	Amloki	April-May	Nov-Dec	9-21	30	365	1,10,000	—	15	16,500
Picea spinulosa	Spruce	March	2w Oct- 2w Nov	28-52	40	210	62,000	—	10	6,200
Pinus gerardiana	Chilgoza pine	Feb-March	Sept-Oct	10-25	60	90	3,000	—	20	600
P. kesiya	Khasipine	Feb	2w Feb- 1w March	6-15	70	730	58,800	—	30	17,840
P. merkusii	Markus pine	March	1w Oct- 1w Nov	6-15	40	730	76,000	—	30	22,800
P. roxburghii	Chir pine	March	2w Nov- 2w Dec	5-15	85	730	9,000	—	40	3,600

(Contd...)

1	2	3	4	5	6	7	8	9	10	11
P. wallichiana	Blue pine	March	4w Sept-2w Nov	6-15	70	545	28,500	—	25	7,125
Polyalthia jenkinsii	Kari	Feb	4w May-2w June	10-32	40	90	32,500	1,400	10	3,250
Populus ciliata	—	March	4w Jan-1w July	12-30	20	560	12,50,000	—	—	—
P. gamblei	—	Dec	4w Feb-2w March	10-28	22	600	12,50,000	—	—	—
Prunus nepalensis	—	May-Jan	Oct-Nov	12-40	80	180	1,400	—	35	490
Pterospermum acerifolium	Hatipoila	April	2w April-2w May	8-50	50	120	19,000	—	15	2,850
Pterygeta alata	Badam	April	2w Feb-1w March	12-17	70	90	910	—	50	455
Quercus griffithii	Bajrar	May	1w Sept-1w Oct	43-60	75	240	740	—	50	365
Q. incana	—	May	3w Sept-4w Oct	35-55	90	90	500	—	50	250
Q. lamellosa	—	May	2w Sept-3w Oct	40-55	65	180	150	—	55	82
Robinia pseudoacacia	Black Locust	May-June	Sept-Oct	10-42	90	3 650	40,000	—	40	16,000
Santalum album	Sandal wood	May & Nov	Sept and March	35-61	35	380	5,300	—	10	530
Sapium baccatum	Selleng	April	2w Aug-2w Sept	7-15	80	30	1,800	—	—	—
Schima wallichii	Makri sal	May	1w Feb-1w March	12-20	40	60	2,00,000	—	25	50,000
Shorea assamica	Mekai	Jan	2w March-2w April	14-44	35	21	—	600	15	90
S. robusta	Sal	March	4w May-1w June	10-35	60	21	—	1,000	40	400

(*Contd...*)

1	2	3	4	5	6	7	8	9	10	11
Spondias pinnata	Amora	March	1w Dec- 1w Jan	30-65	20	180	250	—	10	25
Sterculia villosa	Udal	March	3w April- 1w May	4-15	92	120	3,200	—	80	2,560
Stereospermum chelonoldes	Paroli	March	2w Dec- 2w Jan	5-20	35	90	40,000	—	12	4,800
Swietenia macrophylla	Mahogany	May-June	Dec-March	12-21	40	120	3,800	—	15	570
Syzygium jambolana	Jamuk	March	4w May- 4w June	10-25	—	—	12,000	—	—	—
Taluma phellocarpa	Khorika sopa	May	2w Sept- 3w Oct	25-40	15	28	11,400	—	10	1,140
Tectona grandis	Segun	July	4w Dec- 4w Jan	10-46	42	365	1,200	—	35	420
Terminalia belliraca	Bhoira	April	2w Nov- 2w Dce	20-85	35	545	340	—	25	85
T. citrina	Hilika	May	4w Nov- 4w Dec	25-67	50	730	590	—	42	248
T. myriocarpa	Hollock	Sept	1w Dec- 1w Jan	10-35	58	120	5,00,000	—	8	40,000
Tetrameles nudiflora	Bhelu	March	2w May- 1w June	7-25	50	90	5,95,00,000	—	0.5	2,72,500
Toona ciliata	Jatipoma	Sept	4w Dec- 4w Jan	6-20	60	120	1,53,850	7000	20	30,070
Tsuga dumosa .	Himalayan Hemlock	April	2w Oct- 2w Nov	30-45	80	180	4,00,000	—	10	40,000
Zathoxlum limonella	Bajrang	April	2w Aug- 1w Sept	46-67	15	730	14,000	—	14	1,400

N.B. :

1w — First Week;
2w — Second Week;
3w — Third Week;
4w — Fourth Week;

SUMMARY

There are about 3000 species of flowering plants in Arunachal Pradesh and out of these, about 700 species of forest plants are of economic importance. Observations on flowering, fruiting, germination period and per cent, plant per cent, viability period, weight of seed/fruit and number of seedlings obtained from seeds/fruits of known weight of important species including bamboo and cane were recorded on the basis of trials conducted from 1978 to 1986 These informations will be of much use for the field foresters to collect required quantity of seed/fruit timely. The germination per cent worked out in laboratories are of very little use to the fieldman Under laboratory condition germination per cent of a species may be 90% but under field condition it can be less than 1% specially for minute seed. Plant per cent gives useful information for collection of required quantity of seed.

अरुणाचल प्रदेश के कुछ उपयोगी वन पादपों के पुष्पन फलन और अकुरण व्यवहार के सम्बन्ध में किये गये पर्यावलोकन

वी०एस० बेनीवाल व एन०बी० सिंह

सारांश

अरुणाचल प्रदेश में पुष्पी पादपों की लगभग 3000 जातियाँ हैं। जिनमे से लगभग 700 वन वृक्ष जातियाँ आर्थिक महत्व की हैं। इन जातियों के पुष्पन, फलन, अंकुरण अवधि और प्रतिशत, पादप प्रतिशत, बीज की अकुरण-क्षमता बनी रहने का समय, बीज/फल का भार तथा महत्व की पादप जातियों जिनमे बांस और बेत भी सम्मिलित हैं, के ज्ञात भार के बीजों/फलों से मिल सकने बाले पौधों की संख्या पर 1978 से 1986 तक किये गए सरीक्षणों के आधार पर पर्यावलोकन दिए गए हैं। यह जानकारी बीजों/फलों की अपेक्षित मात्रा समय से इक्टठा करने में क्षेत्र वानिकों के बड़े काम की रहेगी। प्रयोगशालाओं में ज्ञात किए हुए अकुरण प्रतिशत क्षेत्र कर्मियों के लिए बहुत कम उपयोगी होते हैं। हो सकता है कि प्रयोगशालिक दशाओं मे किसी पादप जाति का अकुरण प्रतिशत 90% निकल जाए परन्तु विशेषकर बहुत छोटे बीजों में, क्षेत्र दशाओं में यह प्रतिशत 1% से भी कम आ सकता है। पादप प्रतिशत से बीजो की अपेक्षित मात्रा इकट्ठा करने के लिए उपयोगी जानकारी प्राप्त होती है।

References

Anon. (1984-85) *Annual Research Report*, Silviculture Division, Arunachal Pradesh.

Beniwal, B.S. (1987) Phenological study of trees in Arunachal Pradesh. *Indian For.*, **113** (12) : 779-791

Ganapathy, P.M. and M. Ranga Rajan (1964). A study of phenology and nursery behaviour of Andaman timber species. *Indian For.*, **90** (11) : 758-766.

Sengupta, J.N. (1936). *Indian Forest Records.* **2** (5).

Troup, R.S. (1921). *The Silviculture of Indian Trees.* Vol I-III.

DISEASES OF FOREST TREES IN HIMACHAL PRADESH AND THEIR CONTROL

H.S. SEHGAL, R.K. TIVARI, S.N. KHAN AND B.M. MISRA

Disease Insect Survey,
Forest Research Institute, Dehra Dun (India)

Introduction

Forests in Himachal Pradesh comprise about 38.3% of its total geographical area. Coniferous forests constitute 36.8% of the total forest area spread over 7,851 km² (Anon., 1987). The important conifers of H.P. are *Pinus roxburghii* Sargent (Chir pine), *P. wallichiana* A.B Jackson (Blue pine), *P. gerardiana* Wall. ex Lamb. (Chilgoza pine), *Cedrus deodara* Loudon (Deodar), *Abies pindrow* Royle (Fir) and *Picea smithiana* (Wall.) Boiss (Spruce).

These trees suffer from many diseases, some of which cause serious losses. The diseases of forestry species (except poplars) in nurseries, plantations and natural forests in Himachal Pradesh are being described.

Chir pine (*Pinus roxburghii*)

Needle-blight : The disease caused by *Cercoseptoria pini-densiflorae* (Hori et Nambu) Deighton and first recorded from India on *Pinus radiata* D. Don at Amarkantak, M.P., has now spread to hard pine nurseries in other states including Orissa, West Bengal, Andhra Pradesh, Bihar, Uttar Pradesh and Himachal Pradesh. In Himachal Pradesh, the disease was first recorded during 1985 from Solan on *P. roxburghii*. It is an important disease of pines in nurseries and during early stages of plantations. The disease first manifests in lower needles and slowly spreads upwards. The infection starts at the onset of monsoon. The symptoms include appearance of pale green lesions on needles which turn yellow-brown to greyish brown, later the whole needle turning greyish with a number of minute, dark fruit bodies formed on it. The diseased needles become dry and curl around the stem. Heavy attack causes mortality.

The disease can be successfully controlled by spraying with 1% Dithane M-45 or Dithane Z-78 or 0.8% Calixin at tri-weekly intervals from the onset of monsoon (Singh *et al.*, 1983).

Fusarium wilt : A large scale mortality of chir seedlings due to wilt disease caused by *Fusarium* sp was noticed during 1985 in Dagshai nursery, Dharampur Range. The needles in the growing shoots become flaccid, droop down and finally dry up. The drying then advances downwards, resulting in death of seedlings.

The disease can be controlled by avoiding too dry or too wet condition of the soil. Drenching of soil with 0.1% Emisan-6 was found effective to arrest further spread of disease.

Stem blister rust : The disease is caused by *Cronartium himalayense* Bagchee. Chir pine is susceptible to infection upto an age of about 10-15 years and develop resistance with age. The infected branches are killed and the entire tree may die in case of heavy attack.

C. himalayense is a heteroecious and macrocyclic rust with pycnial and aecial stages on chir; uredial and telial stages on *Swertia* spp. (*S. alata* Royle ex, C B. Cl., *S. angustifolia* Buch.–Ham. ex, D. Don and *S. cordata* Wall. ex, C.B. Cl.). Disease symptoms are manifested by resin exudation followed by bark cracking and canker formation on the branches and stem. Pycnia appear on bark as minute blisters of the size of pinhead followed by orange-yellow aecia (around-March) in the form of larger blisters. Orange yellow or rusty yellow uredia develop on leaves and stem of *Swertia* spp. followed by light brown, filiform telial columns giving a felty appearance. The basidiospores produced on telia infect chir pine, thus completing the life cycle of rust.

Following control measures may be adopted :

(i) Eradication of alternate host, *Swertia* spp. upto a distance of about 300 metres from the edge of chir forest, thus breaking the life cycle of the rust. Such eradication should be continued for about three years.

(ii) Infected pines may be removed to reduce the inoculum in the form of aeciospores.

Chir pine mortality due to a disease-insect pest complex was recorded at Kunihar Forest Division during 1976. Insect pests namely *Hylobius angustus* Faust and *Dioryctria abietella* Denis & Schiffermueller, feeding on the cambium were found associated with chir stem rust, *C. himalayense*. This twin attack hastens the death of the affected plants.

Insect pests may be controlled by spraying Malathion E.C. @ 0.2% or Lindane E.C @ 0.5%.

Needle-rust : *Coleosporium campanulae* (Pers). Lev , the cause of needle rust is common on chir pine throughout its distribution and in all age classes. The rust is heteroecious and macrocyclic. Minute dark orange pycnia followed by orange yellow aecia appear on infecetd needles of chir pine. Uredial and telial stages develop on *Campanula colorata* Wall.

Infection of needles takes place late in autumn and infected needles are shed alongwith healthy ones during April.

Red band disease : *Dothistroma pini* Hulbery, the cause of red band disease, was first reported from India on *Pinus radiata*, an exotic pine, in Palni Hills, Tamil Nadu (Bakshi & Singh, 1967). The fungus has since been recorded on *Pinus roxburghii* and *P. wallichiana* from H.P. Initially yellow chlorotic spots appear on needles, which rapidly become necrotic and assume a reddish tint. The fungus produces black, scattered stromata in the red band area. Infection results in defoliation and severe attack may cause death of the entire plant. The disease can be effectively controlled by copper based fungicidal spray.

Trimmatostroma needle blight : A *Trimmatostroma* sp. causing needle blight is found to commonly occur on *P. roxburghii* in H.P. The disease appears in the outer crown. Infected needles start drying from tip backwards and minute black fruit bodies develop on the dried needles.

Blue pine (*Pinus wallichiana*)

Heart rot : *Fomes pini* (Thore ex Pers.) Lloyd, is a wound parasite and causes heart rot of blue pine throughout its distribution. The incidence is higher in high rainfall areas (100 cm and above) in outer Himalayas but gradually diminishes with decrease in rainfall in the inner ranges of Himalayas.

The fungus causes white pocket rot. The fruit bodies of the fungus develop commonly on infected trees and are usually associated with punk knots.

The practice of lopping of the branches should be prohibited or controlled to minimise the injuries through which infection takes place.

Stem rust : *Cronartium ribicola* Fischer, the stem blister rust of blue pine is recorded from Kulu and Upper and Lower Bashahr Divisions (Bakshi, 1976). The rust is macrocyclic and heteroecious. Pycnial and aecial stages occur on blue pine, uredial & telial stages on *Ribes rubrum* Linn.

The fungus usually attacks branches of young plants which become swollen, blistered and girdled. Resin exudation may also occur.

Needle rust : The disease is caused by *Coleosporium barclayense* Bagchee in the entire range of blue pine forests. The rust attacks trees of all ages infecting only the needles of previous season. Pycnia and aecia develop on blue pine, uredia and telia on *Senecio rufenervis* D.C. Orange-red aecia appear on the needles early in April and increase in number till June. The affected needles are shed at about the same time as the healthy needles.

Dwarf mistletoe : A flowering plant parasite, *Arceuthobium minutissimum* Hook. f., is widespread on blue pine in low rainfall areas in the inner Himalayas, but uncommon in comparatively high rainfall areas. In Himachal Pradesh the parasite is common in dry arid regions of Kinnaur, Lahaul and Pangi Forest Divisions where the incidence may be upto 100% in certain localities (Bakshi, 1976).

The infection results in fusiform swellings on branches or main bole, development of witches'-brooms, top dying and death of affected branches. Heavily infected stands get stunted leading eventually to death of trees.

Infection spreads mainly through sticky seeds ejected from berries with great force, often upto 10 m and adhering to the stem to initiate fresh infection.

In heavily diseased stands it is advisable to clear-fell and regenerate the area. Species substitution with *P. gerardiana* may also be considered.

To minimise chances of fresh infection from an adjoining infected stand, a protective zone of cleared area or other species may be established.

In locations where infection is restricted to branches, pruning of infected branches should be carried out before production of seeds on current season's mistletoe shoots.

Lophodermium needle disease : Various species of *Lophodermium* causing needle cast have been recorded on various pines including *P. roxburghii*, *P. wallichiana*, *P. gerardiana* and *P. pseudostrobus* Lindl. from different localities in H P.

Deodar (*Cedrus deodara*)

Armillariella root rot : Root rot due to *Armillariella mellea* (Vahl ex Br.) Karst., is recorded in natural deodar forests in Kufri and in plantations at Chhachpur causing sporadic mortality (Singh & Khan, 1979).

Infection by *A. mellea* is characterised by thick fungal mat between the bark and wood, brown to brownish-black, flattened rhizomorphs below the bark and fluorescent character of the decayed wood in the dark. The fungus attacks both heartwood and sapwood and causes white fibrous rot. Umbrella shaped yellowish brown fruit bodies develop at the base of the attacked trees.

In the natural forests, *A. mellea* exists in endemic form and the disease spreads in localised patches through root contact or rhizomorphs Further spread is restricted due to presence of other resistant species In plantations the disease is potentially dangerous in pure stand.

Heterobasidion root rot : *Heterobasidion annosum* (Fries) Bref., a serious root rot fungus is found to cause damage to deodar in plantations at Chhachpur and sporadic mortality in natural deodar forests at Kufri (Singh and Khan, 1979).

Infection by *H. annosum* is characterised by thin fungal mat in patches between the bark and the wood, on the bark of the roots looking like splashings of lime wash and cause white rot of wood with small pockets. Fruit bodies develop on affected plants at ground level and are perennial in nature.

Initial infection takes place through basidiospores which infect injured roots or tree bases. The disease further spreads to adjoining trees through root contact and grafts. Following measures are suggested to minimise the disease incidence (Bakshi, 1976) :

(i) By raising mechanised plantations where stumps and residual roots are removed to eliminate the inoculum from infected roots.

(ii) To prevent stump colonisation, freshly cut stumps are treated with the chemicals like Creosote and Urea (20%); Sodium nitrate (10%); herbicides - Reglone and Gramoxone, containing diquat and paraquat respectively (5.5%).

Peridermium witches'-broom : The disease is caused by *Peridermium cedri* (Barclay) Sacc , the needle rust is recorded from Kulu, Manali, Bashahr and various other localities (Bakshi, 1976). The affected needles are shorter, curve backwards and shed earlier. Growth of saplings and young pole crop is affected. The affected branches or the entire tree is transformed into witches'-broom. Heavy attack results in the death of affected branches and the tree.

Systematic removal of diseased parts of trees for a number of years keeps the disease under control. Also, as the wet conditions favour the disease, raising plantations in damp valleys should be avoided.

Ploioderma needle disease : Deodar needle cast caused by *Ploioderma cedri* Singh, Khan and Misra, is recorded in 60 years old plantations at Khadrala and Rohru Forest Divisions (Singh *et al.*, 1987). The initial symptoms of infection are appearance of pale regions on needles followed by development of black, linear fruit bodies. Infected needles subsequently turn yellow and fall off prematurely.

Fir (*Abies pindrow*) & **Spruce** (*Picea smithiana*)

Damping off and seedling wilt : *Pythium* sp., *Rhizoctonia* sp. and *Fusarium avenaceum* (Fr.) Sacc. are recorded from Shillaru nursery, causing damping-off and root rot, resulting in heavy mortality.

The disease can be controlled by soil drenching in the beds with formalin (38-40%-formaldehyde) @ 250 ml. diluted in 4 litres of water per square meter of soil prior to sowing or drenching of beds with copper based fungicides like 0.2% Blitox after sowing (Singh, *et al.*, 1985).

Needle rusts : The following needle rusts on spruce are recorded :

Chrysomyxa deformans (Diet.) Jaczew , a microcyclic rust known only in its telial stage is recorded from Shimla and Dalhousie (Bakshi & Singh, 1967). Current years needles get infected, turn yellow, become twisted and curved at the apices resulting in stunting of shoots. Telia occur in two continuous rows on both the surfaces forming a homogeneous orange-red layer on needles.

Peridermium thomsoni Berk., is recorded from Shimla and Kulu but is not very common (Bakshi, 1976). It attacks the current season's needles. The diseased shoots assume a uniform pale colour. In advance stages the needles curve outwards. The affected twigs at this stage droop down as long orange-coloured tassels. Reddish orange aecia occur in two rows on the convex portion of the curved needles.

Ceropsora piceae (Barclay) Bakshi & Singh, is common all over Western Himalayas wherever the host is present (Bakshi & Singh, 1967). Needles of previous year are attacked. Telia develop in a single row on the upper side of each needle and the tissues around the telia become discoloured.

Peridermium piceae (Barclay) Sacc., is known only in the aecial stage on spruce needles and is recorded from Shimla (Bakshi 1976). Needles of current season's growth are attacked. Affected needles become and are shed prematurely. Severely affected twisted trees may die (Singh, *et al.*, 1987).

Infection of *P. piceae* on spruce was observed to be heavy in association with *Rhododendron arboreum* Sm. trees attacked by *Chrysomyxa himalensis* Barclay. The artificial cross inoculations proved that *P. piceae* (Barclay) Sacc. attacking spruce is an alternate stage of *Chrysomyxa himalensis* Barclay (Singh *et al.*, 1987).

Discosia needle spot : *Discosia strobilina* Lib. is recorded on spruce from natural forest around Shillaru (Singh, *et al.*, 1987). The fungus attacked mostly the natural regeneration though needles of pole-size trees were also found affected. Typical flattened pycnidia develop on dark red zones on the affected needles. In seedlings heavy attack resulted in premature defoliation.

Other diseases recorded from H.P. are briefly mentioned below.

Acer **sp.**

Leaf spot : *Cylindrosporium* sp. recorded from Kotgarh Forest Division causes dark reddish-brown, irregular spots with a pale hyaline centre on the upper surface of leaves.

Cupressus torulosa **D. Don**

Twig rust : *Gymnosporangium cunninghamianum* Barclay, a heteroecious rust with pycnia and aecia on *Pyrus pashia* Ham. and telia on *Cupressus torulosa* was recorded from Shimla. The telia develop on green twigs as round or elongate dark brown thick pads (Bakshi & Singh, 1967).

Juglans regia **Linn.**

Powdery mildew : *Microsphaera alni* DC. ex Wint. is recorded from Kulu. It forms a white to greyish white powdery coating on leaves (Chona *et al.*, 1960).

Melia azedarach **Linn.**

Leaf spot : *Cercospora leucosticta* Ell. & Ev. is recorded from Solan causing yellowish brown circular leaf spots.

Rhododendron arboreum, *R. campanulatum* **D. Don and** *R. hodgsonii* **Hook.**

Leaf rust : *Chrysomyxa himalensis* Barclay is recorded from Shimla and Sarahan. Telia almost clothe the petioles and leaf blade upto a short distance along the midrib. Affected shoots remain stunted producing smaller leaves and forming witches' brooms (Singh *et al.*, 1987).

Robinia pseudoacacia **Linn.**

Powdery mildew : *Phyllactinea guttata* (Wall. ex. Fr.) Lev. is recorded from Solan. It forms white powdery coating on the lower surface of the leaves with minute, globular, dark coloured perithecia.

Salix caprea **L.**

Powdery mildew : *Uncinula adunca* (Wall. ex. Fr.) Lev. is recorded from Solan. It forms white to grey powdery coating on leaves.

Salix tetrasperma **Roxb.**

Tar spot : *Rhytisma salicinum* Fr. is recorded from Shimla. It forms thick black tar spots on the upper surface of the leaves.

Salix **sp.**

Powdery mildew : *Uncinula* sp. is recorded from Theog. It produces white powdery coating on leaves.

Continuous surveillance is necessary to evaluate the present status of existing diseases in nurseries, plantations and natural forests and to detect new disease outbreaks and identify their causes. Strategies for adoption of suitable control measures can be formulated after assessing the actual and potential threat of disease outbreaks.

SUMMARY

The diseases of forestry species (except poplars) in nurseries, plantations and natural forests in H.P. are described along with their control measures, giving details only of potential important ones. The importance of continuous surveillance of forests is stressed.

हिमाचल प्रदेश के वन वृक्षों के रोग तथा उनकी रोकथाम

एच०एस० सहगल, आर०के० तिवारी, एस०एन० खां व बी०एम० मिश्र

सारांश

हिमाचल प्रदेश की रोपणियों, रोपवनों और प्राकृतिक वनों में लगी हुई वृक्ष जातियों (पोपलर को छोड़कर) को होने वाले रोगों का वर्णन, उनके नियन्त्रण उपायों सहित दिया गया, किन्तु विस्तार केवल संभावी महत्वपूर्ण रोगों का ही दिया गया है। वनों की निरन्तर जांच-पड़ताल करते रहने के महत्व पर बल दिया गया है।

References

Anon. (1987). Himachal Forests. Forest Press. Solan–11.

Bakshi, B.K. and S. Singh (1967). Rusts on Indian Forest Trees. *Indian For. Rec.* **2** : pp. 1-198, with 6 plates.

Bakshi, B.K. (1976). Forest Pathology-Principles and practice in forestry. Controller of Publications, Delhi, pp. 400.

.... (1977). Disease-Insect Survey Report (1975-77). FRI, Dehra Dun, pp. 1-46.

Chona, B.L., J.N. Kapoor and H.S. Gill (1960). Studies on powdery mildews from India-I. *Indian Phytopath.* **13** : 72-75.

Singh, Ombir; S.P. Chaukiyal and H.P. Sharma (1985). Control against damping off in spruce nurseries. *Indian J. For.* **8** (4) : 321-322.

Singh, S., and S.N. Khan (1979) *Fomes annosus* & *Armillaria mellea* root-rots in Deodar & Fir in Western Himalayas. *Ind. J. For.* **2** (2) : 141-145.

Singh, S., S.N. Khan, B.M. Misra and Kamla Uniyal (1982). Some important diseases of hard pines in India. *Indian For.*, **108** (1) : 86-92.

Singh, S., S.N. Khan, B.M. Misra and D.S. Rawat (1983). Control of Cercoseptoria needle blight of pines in nurseries by fungicides. *Indian For.*, **109** (8) : 578-586.

Singh, S., S.N. Khan and B.M. Misra (1987). Two new species and some noteworthy records of fungi on Indian Conifers. *Indian For.*, **113** (5) : 359-365.

SOIL CHEMICAL PROPERTIES OF SILVER FIR AND SPRUCE FOREST UNDER DIFFERENT SYSTEMS OF SILVICULTURE.

I—CHANGES IN SOIL NITROGEN

M.K. GUPTA, R.P. SINGH AND M.N. JHA*

Conifers Research Centre, Shimla (Himachal Pradesh)

Introduction

The chemical make up of soil governs the enrichment of the soil solution which determines the nutrient uptake by plants. The soil nitrogen levels in temperate forests such as Silver Fir and Spruce are maintained mainly due to the organic fraction of the soil. The organic matter from which most of the soil nitrogen derives, is the result of interaction of several factors (Waheed Khan and Yadav, 1962; Yadav, 1963) over a period of time.

The natural forests in these temperate regions such as at Narkanda, Himachal Pradesh have been managed through three silvicultural systems—selection, shelterwood and clearfelling. The soil nitrogen levels show sensitivity to the management practices in agriculture and hence, it was our objective to see if the soil nitrogen shows changes due to such practices in forests at Narkanda. Taylor *et al.*, 1934, 1936; Puri and Gupta, 1951; Yadav, 1963 and Dhir, 1967, 1970 reported observations on the temperate forests of India for the first time. This paper shows the results of the studies on soil N carried out in Narkanda forest area of the Himachal Pradesh.

Materials and Methods

This study was carried out at Kumar Sain Forest Range of Shimla Circle at Narkanda, Himachal Pradesh. The study site lies at 77° 27′ 30″ E longitude and 31° 15′ 30″ N latitude and the altitude varies between 2600 m 2750 m above mean sea level. It is a temperate zone with 900 mm to 1600 mm annual rainfall. The soil of this area is of medium extend with slightly acidic pH. The test area is dominated by evergreen coniferous species such as *Picea smithiana* and *Abies pindrow* with some broad leaved species like *Asculus indica*, *Quercus* sp., *Juglans regia*, *Acer* sp. and *Trunus cornuta*.

The area managed under the three silvicultural management systems i.e. selection, shelterwood and clearfelling were selected for this study. Selection system consists of removal of mature timber such as the older and larger trees either as single scattered ones or in small groups at relatively short intervals and repeated, indefinitely by means of which continuous establishment of natural reproduction is encouraged and an unevenly aged stand is maintained. Shelterwood felling includes removal of mature timber in a series of cuttings which extend over a period of years by means of which the establishment of natural reproduction under the partial shelter of seed trees is encouraged, while in clearfelled management system the entire stand is removed at one time.

---

* Head, Ecology and Conservation Division, Forest Research Institute, Dehra Dun.

In a given management system, the good, average and poor sites were selected for investigations. These sites were selected on the basis of diameter at breast height, height, crown area, tree density ground flora status, soil depth and general appearance of the site. A site was termed good where trees have attained full growth potential and density, and there was appreciable accumulation of litter on the forest floor. The site was termed average where these parameters were not expressed to the fullest extent. The site was termed average where these parameters were apparently quite low.

Three soil profiles were exposed at each site under three management systems and soil samples were taken at predetermined depths i.e. 0-10; 10-25; 25-50; 50-75; 75-100 cm and 100 + cm. Total nitrogen was determined by kjeldahl method as described by Jackson (1967), while available nitrogen was estimated by alkaline permanganate method as described by Subbiah and Asija (1956).

Results and Discussions

Though there has not been any full-proof procedure in forestry to differentiate the relative richness of the sites, some efforts have been made by considering certain parameters on which sites could be termed as good, average and poor in all the management systems. Hotelling's T^2 test was carried out on the basis of physico-chemical characteristics of soil of each site to determine whether sites have statistically significant differences or not (Table 1). From the results it is clear that all the sites were significantly different from each other.

Table 1

Hotelling's T^2 test showing the difference between sites on the basis of soil properties.

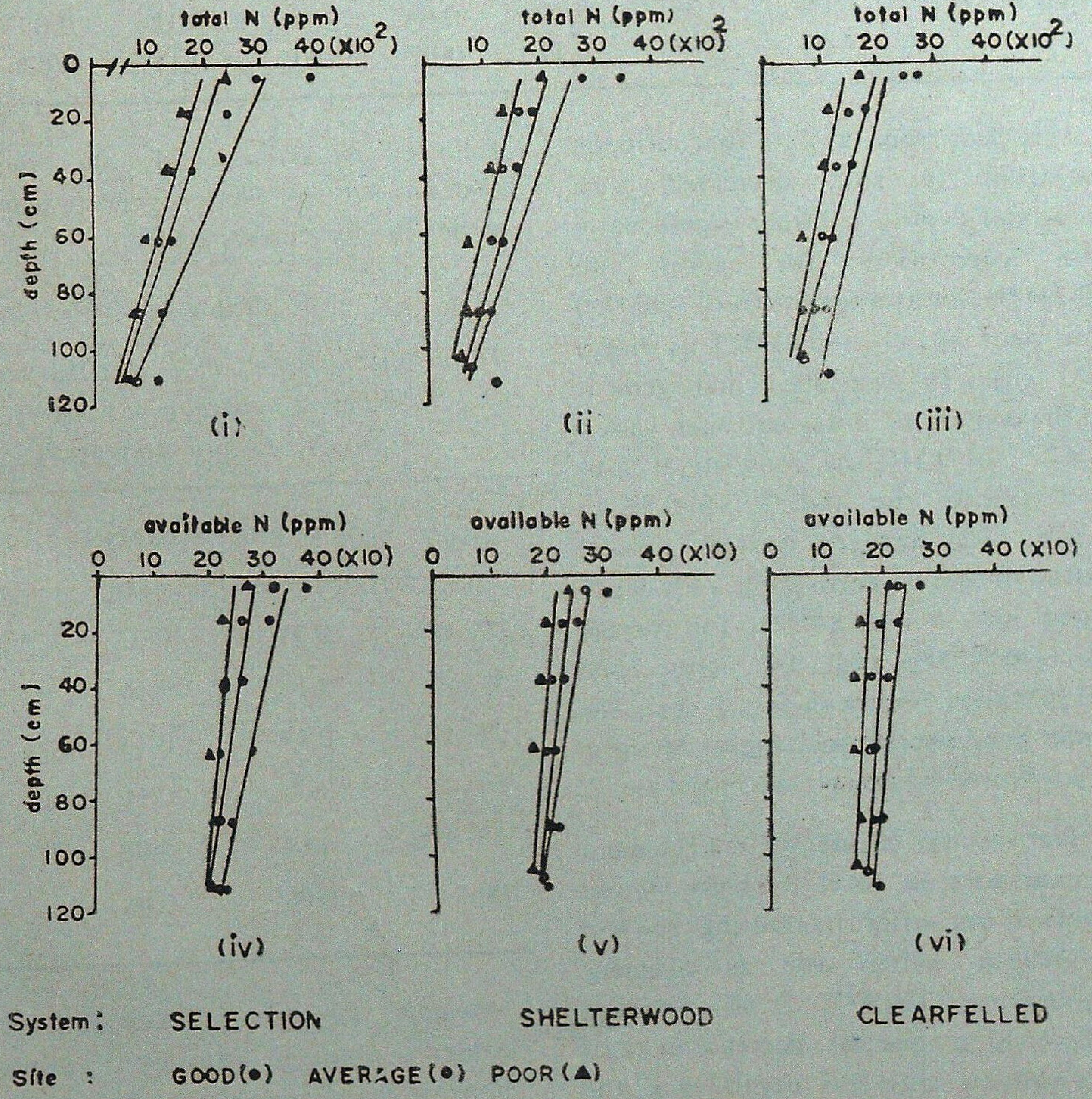
Sites	T^2	Level of Significance
Selection good Vs Selection average	474.92	***
Selection average Vs Selection poor	640.76	***
Selection good Vs Selection poor	1743.88	***
Shelterwood good Vs Shelterwood average	905.03	***
Shelterwood average Vs Shelterwood poor	297.97	***
Shelterwood good Vs Shelterwood poor	420.87	***
Clearfelled good Vs Clearfelled average	459.99	***
Clearfelled average Vs Clearfelled poor	771.22	***
Clearfelled good Vs Clearfelled poor	2248.05	***

*** = Significant at 0.1% level.

Total Nitrogen: Total nitrogen values obtained from good, average and poor sites of selection management systems are presented in Table 2.

The data showed a uniform distribution pattern in soil in all three sites. It varied from 0.39 to 0.11% in good, 0.30% to 0.07% in average and 0.23 to 0.05% in poor site. The total nitrogen contents decreased with increasing soil depth in all three sites with significant negative correlation for good site (r=—0.85***), for average site (r=—0.87***) and for poor site (r=—0.93***) as shown in Fig. 1 (i). In shelterwood system total nitrogen varied from 0.34 to 0.11% in good site, 0.27 to 0.07% in average site and 0.02 to 0.05% in poor site.

Fig 1.



Distribution of soil nitrogen in good, average and poor site under different management systems.

Table 2

Distribution of total nitrogen (%) in soil under different management systems and sites

Soil depth (cm)	Selection			Shelterwood			Clearfelled		
	Good	Average	Poor	Good	Average	Poor	Good	Average	Poor
0 - 10	0.39	0.30	0.23	0.34	0 27	0.20	0.27	0.25	0.17
10 - 25	0.24	0.17	0.15	0.19	0.16	0.13	0.17	0.15	0.11
25 - 50	0.17	0.14	0.14	0.16	0.13	0.11	0.15	0.13	0.11
50 - 75	0.14	0.11	0.09	0.12	0.11	0.07	0.12	0.10	0.06
75 - 100	0.12	0.08	0.06	0.10	0 09	0.06	0.12	0.08	0.06
100+	0.11	0 07	0.05	0.11	0 07	0.05	0.11	0.07	0 05

It is clear from the data that nitrogen concentration in soil decreased with increasing soil depth, showing significantly negative correlation for good site (r=—0.79***), for average site (r=—0.86***) and for poor site (r=—0 91***) as shown in Fig. 1 (ii). In clearfelled management system the content of total nitrogen varied from 0.27 to 0.11% in good site, 0.25 to 0.07% in average site and 0.17 to 0 5% in poor site. The nitrogen content showed significantly negative correlation with depth for good site (r=—0.84***), for average site (r= —0.89***) and for poor site (r=—0.91***) as shown in Fig. 1 (iii). The soil under good site showed higher nitrogen content followed by average and poor sites.

The specific effects of management systems and sites on total nitrogen content were worked out after integrating the soil total nitrogen values for management systems and sites (Table 3). It was observed that there is a general decrease in total nitrogen content with soil depth in all the three management systems. Soil under selection system showed higher enrichment followed by shelterwood and clearfelled systems due to denser canopy conditions under the former system.

Table 3

Total soil nitrogen (%) distribution under different management systems (when sites are integrated).

Soil depth (cm)	Selection	Shelterwood	Clearfelled
0– 0	0.31	0.27	0.23
10–25	0.19	0.16	0.14
25–50	0.15	0.13	0.13
50–75	0.11	0.10	0.09
75–100	0.09	0.08	0.09
100+	0.08	0.08	0.07

Available Nitrogen : Available nitrogen contents obtained from good, average and poor sites of selection, shelterwood and clearfelled management systems have been shown in Table 4.

Table 4

Distribution of available nitrogen (%) in soil in different management system and sites

Soil depth (cm)	Selection			Shelterwood			Clearfelled		
	Good	Average	Poor	Good	Average	Poor	Good	Average	Poor
0 - 10	0.038	0.032	0.027	0.031	0.028	0.024	0.027	0.023	0.020
10 - 25	0.031	0.026	0.023	0.025	0.023	0.020	0.023	0.020	0.016
25 - 50	0.026	0.023	0.023	0.023	0.020	0.019	0.021	0.018	0.015
50 - 75	0.028	0.022	0.020	0.022	0.020	0.018	0.019	0.019	0.015
75 - 100	0.024	0.022	0.021	0.022	0.021	0.019	0.020	0.018	0.016
100+	0.023	0.021	0.020	0.021	0.019	0.017	0.019	0.017	0.015

Available nitrogen content varied in different soil depths from 0.038 to 0.023% in good site, 0.032 to 0.021% in average site and 0.027 to 0.020% in poor site under selection management system. The values decreased with increasing soil depth in all sites with significant negative correlation (r=—0.80***) for good site, (r=—0.82***) for average site and (r=—0.84***) poor site as shown in Fig. 1 (iv).

Available nitrogen varied from 0.031 to 0.021% in good site, 0.028 to 0.019% in average site and 0.024 to 0.017% in poor site in shelterwood management system. Values tended to decrease down the soil profile with significant negative correlation for good site (r=—0.81***), for average (r=—0.76***) and for poor sites (r=—0.80***) as shown in Fig. 1 (v).

Available nitrogen contents decreased down the profile in all three sites and varied from 0.027 to 0.019%, 0.023 to 0.017% and 0.020% to 0.015% in good, average and poor sites in clearfelled management system respectively. The contents showed signficant negative correlation for good site (r=—0.83***) for average site (r=—0.82***) and for poor site (r=—0.61***) as shown in Fig. 1 (vi).

Specific effects on management systems and site on available nitrogen content were observed by integrating available nitrogen values for management systems and sites separately (Table 5).

Table 5

Available soil nitrogen (%) at different depths in different management systems (when sites are integrated).

Soil depth (cm)	Selection	Shelterwood	Clearfelled
0–10	0.032	0.027	0.023
10–25	0.026	0.023	0.019
25–50	0.024	0.020	0.018
50–75	0.023	0.021	0.017
75–100	0.022	0.020	0.018
100+	0.021	0.019	0.017

A decreasing trend was observed in available nitrogen contents down the soil profile by integrating the management systems and site conditions. Available nitrogen under the selection system and good site was better maintained as compared to shelterwood and clearfelled management system and under average and poor sites. It showed that available nitrogen content remains inadequate in the absence of trees or due to low tree density mainly because of lack of accumulation of organic matter on forest floor.

The total nitrogen showed significantly positive correlation with available nitrogen in all sites and management systems with r = 0.82*** in selection good, r = 0.92*** in selection average, and r = 0.86*** in selection poor; r = 0.91*** in shelterwood good, r = 0.84*** in shelterwood average, and r = 0 87*** in shelterwood poor, r = 0.98*** in clearfelled good, r = 0.78*** in clearfelled average, and r = 0.85*** in clearfelled poor site (Table 6). Minhas and Bora (1982) also reported a highly significant positive correlation between total and available nitrogen in

Table 6

Relationship of soil nitrogen with the depth under different silvicultural management systems and sites

Silvicultural management systems	Site	Total nitrogen	Available nitrogen
Selection	Good	r = —0 85*** y = 3181.15 — 22.03x	r = – 0 86*** y = 345.20 — 1.15x
	Average	r = —0 87*** y = 2422.63 — 17.50x	r = — 0.82*** y = 287 43 =0.82x
	Poor	r = —0.93*** y = 2086.38 — 15.47x	r = — 0.84*** y = 252 46 — 0.54x
Shelterwood	Good	r = — 0.79*** y = 2678.14 — 17.39x	r = — 0 81*** y = 278.80 — 0.77x
	Average	r = — 0 86*** y = 2249.27 — 15.37x	r = —0.76*** y = 251.54 — 0.62x
	Poor	r = —0.91*** y = 1745.18 — 12.92x	r = — 0.80*** y = 221.21 — 0.50x
Clearfelled	Good	r = —0.84*** y = 2070.88 — 12.36x	r = — 0.83*** y = 248.60 — 0.62x
	Average	r = —0 89*** y = 2110.56 — 14.95x	r = —0.82*** y = 215.18 — 0.44x
	Poor	r = —0 01*** y = 1532.88 — 10.43x	r = —0.61*** y = 182.64 — 0.36x

Himachal Pradesh soils. It was found that distribution of nitrogen is heavily leaned towards the upper layers, mainly because of higher accumulation of the organic matter in the top layer which decreased down the soil depth like nitrogen in all management systems. Increase in total nitrogen content due to higher organic carbon content of soils in higher altitude has also been reported by Nath and Deori (1976) and Palaniappan *et al* (1978). The main source of nitrogen in soil humus was also observed by Cheng (1977). A change in organic matter was found to be responsible for a change in nitrogen content (Hann, 1977). This trend is in conformity with the findings of Gupta and Rorison (1975), Yadav (1963), Yadav and Singh (1976) and Dhir (1967). The enrichment of soil profile has been found to be intimately related to the extent of canopy coverage provided by selection and shelterwood systems. Some idea of annual enrichment of forest floor can be had from the report of Singh *et al.* (1984), who estimated about 44 kg/ha in silver fir and 22 kg N/ha in spruce forest. Soils of Coniferous forest were found to be rich in organic matter and nitrogen content (Yadav, 1963). The content of total nitrogen and available nitrogen have also been shown to fluctuate due to the management practices in agricultural soils. Though this comparison may not be so much appropriate for the forest soils, almost a similar trend due to the effects of differential clearing of forest as well as site condition is of interest.

SUMMARY

Silvicultural management practices have differential impact on soil properties according to the system followed. An investigation was carried out in *Picea smithiana* and *Abies pindrow* forests managed under selection, shelterwood and clearfelled systems in Kotgarh Forest Division (H.P.) to quantify the differences in soil nitrogen status at different sites in the three management systems. Inter-correlation between total and available nitrogen, correlation of nitrogen status with soil depth in all the conditions have been reported Soils under selection system showed higher nitrogen accumulation followed by shelterwood and clearfelled systems. Soil nitrogen showed significant negative correlation with depth in all sites and management systems. Available and total nitrogen showed significant positive correlation in all sites and management systems.

Key words : Conifer Forests, Silvicultural Management, Soil Fertility, Soil Nitrogen, Site Fertility, Silver Fir, Spruce.

विभिन्न वन संवर्धन प्रणालियों के अधीन रोप्य तालीशपत्र और प्रसरल वनों की मृदा-रामायनिक विशेषताएं —I— मृदा के नाइट्रोजन में आने वाला परिवर्तन

एम०के० गुप्त, आर०पी० सिंह व एन०एम० झा

सारांश

वन संवधन प्रक्रियाओं की गृहीत प्रणाली के अनुसार वहाँ की मृदा विशेषताओं पर भिन्न-भिन्न प्रभाव पड़ता है। चयन, रक्षवितान, और निश्शेष पातन प्रणाली के अधीन कोटगढ़ वन मण्डल (हि० प्र०) में लगे पीसिया स्मिथियाना व एबीज पिंड्रो वनों का प्रबन्ध करने पर इन तीन प्रबन्ध प्रणालियों का भिन्न-भिन्न स्थानों

के मृदा नाइट्रोजन की स्थिति में हुए परिवर्तन का मात्रांकन करके एक अन्वेषय किया गया । समग्र और उपलब्ध नाइट्रोजन का पारस्परिक सहसम्बन्ध, और सभी दशाओं में मृदा की गहराई के साथ नाइट्रोजन स्थिति का सहसम्बन्ध भी बताया गया है । चयन प्रणाली मे नाइट्रोजन का जमाव सबसे अधिक निकला, उसके बाद क्रम से रक्षवितान और निशशेष प्रणालियां रही । सभी स्थानों और प्रबन्ध प्रणालियों में गहराई के साथ मृदा नाइट्रोजन का सार्थक ऋण सहसम्बन्ध पाया गया । उपलब्ध और समग्र नाइट्रोजन का सहसम्बन्ध सभी स्थानों पर और सभी प्रबन्ध प्रणालियों मे सार्थक धनात्मक पाया गया ।

References

Cheng, B.T. (1977) Soil organic matter as a plant nutrient. *Soil Organic Matter Studies* Vol. I. IAEA, Vienna 31-39 p.

Dhir, R.P. (1967). Pedological characteristics of some soils of North-western Himalayas. *J. Indian Soc. Soil Sci.* **15** (1) : 61-69.

.... (1970). Transformation of organic residues and its relationship to soil development under high altitude forests. *Indian For.*, **96** (8) : 573-579.

Gupta, P.L. and I H. Rorison (1975) Seasonal differences in the availability of nutrients down a podzolic soil profile. *J. Eco.* **63** (2) : 521-534.

Hann, S. De. (1977). Humus, its formation, its relation with the mineral part of the soil and its significance for soil productivity. *Soil Organic Matter Studies* Vol. I. IAEA Vienna 21-30 p.

Jackson, M L. (1967). *Soil Chemical Analysis.* Prentice Hall of India Pvt. Ltd., New Delhi.

Minhas, R.S. and N.C. Bora (1982). Distribution of organic carbon and forms of nitrogen in a topographic sequence of soils *J. Indian Soc. Soil Sci.* **30** (2) : 135-139.

Nath, A.K. and M.L. Deori (1976). *J. Indian Soc. Soil Sci.* **24**, 279.

Palaniappan, R., K.K. Krishnamoorthy and G. Ramanathan (1978). *J. Indian Soc. Soil Sci.* **26**, 79.

Puri, G.S. and A.C. Gupta (1951) The Himalayan conifers. II. The Ecology of humus in conifers forests of Kulu Himalayas. *Indian For*, **77** (1) : 55-63.

Singh, R P., H.N. Mathur and M.K Gupta (1984). Litter production and release of nutrients in coniferous forest of Himachal Pradesh. *Indian For.*, **110 (10)** : 1014-1022.

Subbiah, B.V. and G.L. Asija (1956). A new method of determining available nitrogen in soil. *Curr. Sci* **25** : 259

Taylor, E. M., M.L. Mehta and R.C. Hoon (1934). An investigation of some Bajrundi forest soils with reference to regeneration of spruce fir (*Picea morind*). *Indian For.*, **60** (6) : 388-401.

Taylor, E.M., I.D. Mahendru, M.L. Mehta and R.C. Hoon (1936). A study of the soils in the hill areas of Kulu Forest Division, Punjab, Part I. An investigation of soil profile under deodar, spruce, blue pine and chir. *Indian For. Rec.* (New Series). Silviculture **1** (2) : 289-346.

Waheed Khan, M.A. and J.S P. Yadav (1962). Soil survey and classification for forest use. *Indian For.* **88** (5) : 337-347.

Yadav, J.S.P. (1963). Studies on soil profiles in Chakrata Division of Uttar Pradesh. *Indian For.*, **89** (1) : 18-38.

Yadav, J.S.P. and K. Singh (1976). Effect of Forest Plantations on water stable aggregates on soil. *J. Indian Soc. Soil Sci.* **24** (4) : 364-368.

ROLLING OF LOGS IN FELLING COUPES : A POTENTIAL DISEASE HAZARD IN CONIFEROUS FORESTS

SUJAN SINGH AND P.C. PANDEY

Forest Pathology Branch,
Forest Research Institute, Dehra Dun (India).

Introduction

In Himachal Pradesh, forests of silver fir, spruce and blue pine are being extensively exploited to meet the increasing demand of saw mills who are engaged in manufacture of packing cases for packing fruit, mainly apple. After felling, the trees are converted into billets of 55 cm, 90 cm and 115 cm log lengths at the felling site and these billets are then rolled down the hill slopes and collected at road side (Plate 1, Fig. 1) for further transport to timber depots. While rolling downwards, these billets strike against stem of standing trees and cause extensive wounds (Plate 1, Fig. 2-4). The present paper includes studies conducted in some felling coupes to determine the incidence of such wounds and the likely impact of these wounds on future health of residual trees.

Area of study

Field studies were conducted in Kotgarh and Rampur Forest Divisions of Himachal Pradesh during 1985 and 1986 in the following areas :

1. Compartments 1 and 4, Chhichhar Block, Kummar Sain Range, Kotgarh Forest Division. Felling in Compt. 1 was done in 1981 and in Compt. 4 in 1984.

2. Compartments 2 and 3, Sidhpur Block, Kotgarh Range, Kotgarh Forest Division. Felling in Compartment 2 was done in 1982 and in Compartment 3 in 1981.

3. Compartment 1, Peogan, Rampur Forest Division. Felling in this Compartment was done in 1979.

Sampling of standing trees was confined to slopes bordering gorges along which the billets are usually rolled down.

Incidence of wounds : Wounds due to rolling of logs were usually found to occur upto 2-3 m from ground level though in some cases, the billets got bumped so high after striking tree trunks that they caused wounds upto 5-7 m from ground level. Exposed roots at ground level were also found badly wounded by rolling billets. Data on number of wounds on standing trees due to rolling of billets are given in Table 1.

It is evident from the data presented in Table 1 that incidence of wounds on standing trees due to rolling of billets was very high in all felling coupes.

Incidence of decay in wounds caused by rolling of billets : Core samples with the help of Pressler borers were taken from suspected decayed patches in the wounds. Depth of the decay in the stem/root was measured from these core samples and the wounds were categorized into two groups i.e. wounds with superficial decay penetrating to less than 1.0 cm depth and wounds with decay penetrating 1.0 cm and above in depth. The data on incidence and depth of decay in the stem/roots are given in Table 2.

Table 1

Incidence of wounds on standing trees due to rolling of billets.

Lacality with year of felling	Trees sampled (No.)	Trees wounded (%)	No. of Wounds	Average wounds per wounded tree
Compartment 1, Peogan, 1979	50	100	112	2.24
Compartment 3, Sidhpur, 1981	50	86	75	1.74
Compartment 1, Chhichhar, 1981	50	62	44	1.42
Compartment 2, Sidhpur, 1982	50	60	54	1.80
Compartment 4, Chhichhar, 1984	50	78	82	2.10
Total	250	77.2	367	1.90

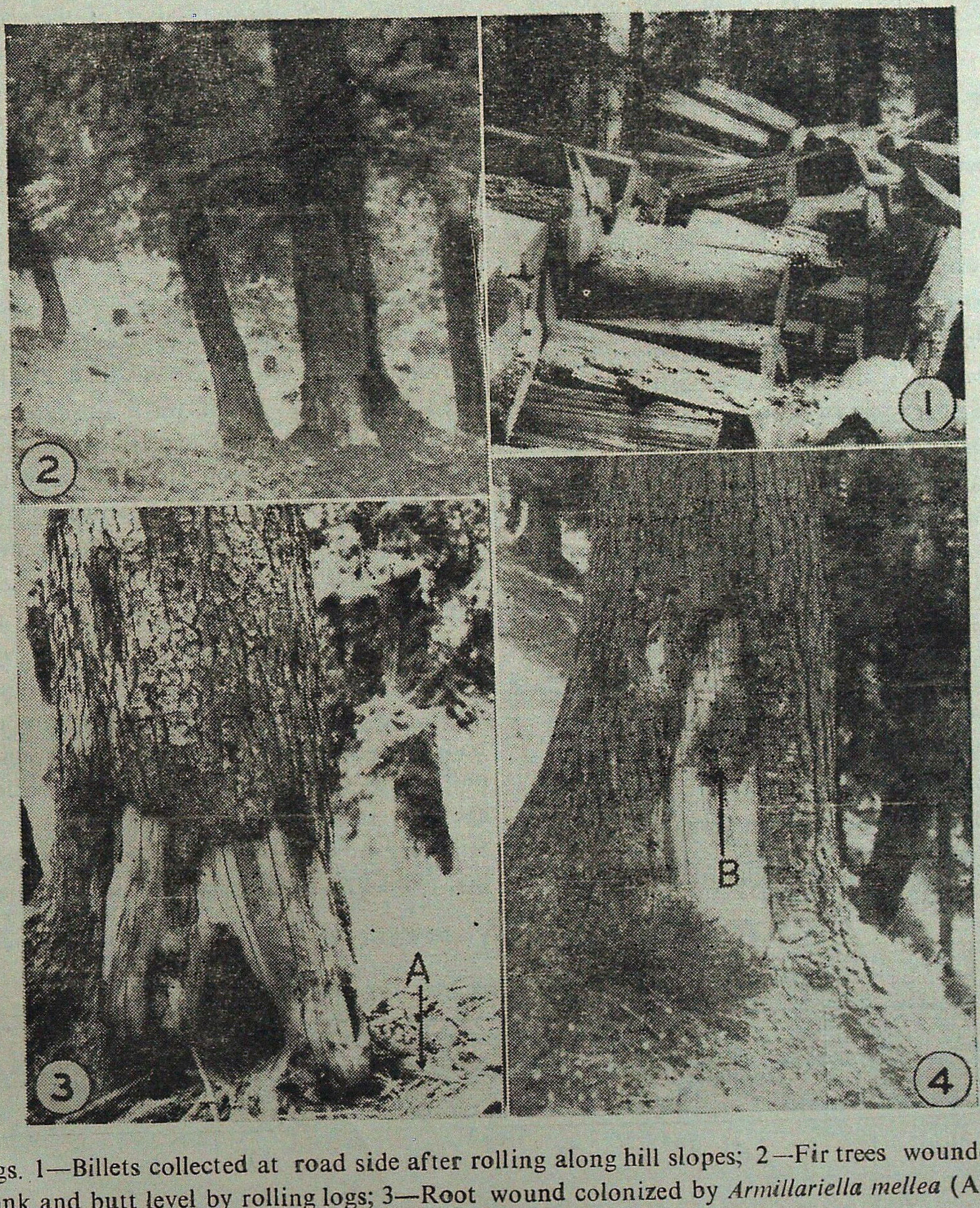
Table 2

Incidence and depth of decay in wounds

Locality with year of felling	Wounds (No)	Wounds with decay (%)	Wounds with decay depth			
			Less than 1 cm		1 cm and above	
			No.	(%)	No.	(%)
Compartment 1, Peogan (1979)	112	39.3	5	11.36	39	88.64
Compartment 3, Sidhpur (1981)	75	69.3	40	76.92	12	23.08
Compartment 1, Chhichhar (1981)	44	56.8	10	40.00	15	60.00
Compartment 2, Sidhpur (1982)	54	37.0	9	45.00	11	55.00
Total	285	49.5	64	45.39	77	54.61

No. of trees sampled in each locality : 50.

Plate 1



Figs. 1—Billets collected at road side after rolling along hill slopes; 2—Fir trees wounded on trunk and butt level by rolling logs; 3—Root wound colonized by *Armillariella mellea* (A) and 4—Fir trees wounded on trunk near ground level and wound colonized by *Polyporus schweinitzii* (B).

The wood with superficial decay (less than 1.0 cm deep) had been attacked by staining fungi, decay fungi, soft rot and moulds. Decay 1.0 cm or above in depth was, in most cases, found to establish either as sap rot or heart rot. The data in Table 2 indicates that on an average fungal decay had penetrated 1.0 cm or more in depth in more than 50 per cent wounds to subsequently establish either sap rot confined to dead wood in wounds or trunk rot or root and butt rot.

Incidence of trunk wounds versus root and butt wounds : In two compartments i e. Compt. 1, Chhichhar and Compt. 1, Peogan, wounds on trunk and root and butt region were counted separately. The data are given in Table 3.

The data in Table 3 indicate that chances of wounding on trunk and root and butt regions of standing trees due to rolling of logs are more or less same.

Fungi associated with wounds : Fungi detected on wounds may be categorised into three groups, namely sap rot fungi, trunk rot fungi and root and butt rot fungi.

Sap rot fungi : These fungi established on wounds 2-3 years after wounding and the decay caused by them was confined to dead sapwood only. Fruit bodies of *Polyporus versicolor*, *P. abietinus*, *Stereum* sp. and *Trametes* sp were found developing on decayed sapwood of wounds in some trees. All these fungi are common slash decay fungi and cause decay in standing dead trees, tree stumps and logs and branches lying on the forest floor.

Trunk rot fungi : When the decay was found to establish deep in the wounds, it was considered that the trunk rot had established in the trees. Trunk rot is a progressive decay and continues to increase with increasing age of trees. Such fungi are known to establish in heartwood of standing trees after the wood had been colonized by non-hymenomycetous and hymenomycetous fungi (Shigo, 1972; Sujan Singh & Tivari, 1970). In present studies, trunk rot was found to establish on 6-7 year old wounds only. In 1981 and 1982 felling coupes, trunk rot had established on two wounds only, one each in 1981 and 1982 felling coupes. In 1979 fellings, trunk rot had established on 9 wounds. It is thus evident that trunk rot established late in succession

Table 3

Incidence of trunk wounds versus root and butt wounds.

Locality	Total wounds	Trunk wounds		Root and butt wounds	
		No.	(%)	No.	(%)
Compartment 1, Chhichhar	44	25	56.8	19	43.2
Compartment 1, Peogan	112	39	34.8	73	65.2
Total	156	64	41.0	92	59.0

after the dead sapwood was completely colonized by other fungi including those causing sap rot. Two fungi causing trunk rot were identified as *Polyporus schweinitzii* (Pl. 1, Fig. 4) and *Fomes geotropus.* Fruit bodies of *F. geotropus* were found only on one wound. In rest of eight wounds, no fruit bodies of any decay fungus were found Examination of activated fungal growth on decayed wood collected from these wounds revealed that the decay in all these cases had been caused by *P. schweinitzii* Both these fungi cause brown cuboidal rot.

Root and butt rot : Root and butt rot was also found to establish on 5-7 year old wounds only. In 1981 and 1982 felling coupes, root-rot was found on two trees only but in 1979 felling coupe, root-rot had firmly established and spread on unwounded regions on 10 out of 50 trees assessed in this locality. Two fungi were identified as the cause of root-rot. These were *Heterobasidion annosum* and *Armillariella mellea. H. annosum* was recorded on two trees only while in all the rest of trees, *A. mellea* was recorded (Pl. 1, Fig. 3). In some wounds which were colonized by *A. mellea,* the fungus had developed black, shoe-string like rhizomorphs on the decayed wood. Wood decayed by *H. annosum* had indistinct pockets while that by *A. mellea* was watersoaked and was lumenescent when it was placed in darkness.

Callusing of wounds : Any wound inflicted on the living tree is callused over by growth of cambial cells surrounding the wounds. Such callus growth takes place all around the wounded region. A study was made in 1, 4 and 7 year old wounds in 1985, 1982 and 1979 felling coupes to determine the extent of callusing in wounds. The data is presented in Table 4.

The data given in Table 4 indicates that on an average 1.08 cm of wound on one side or 2.16 cm from both sides along the stem was covered every year by the callus growth.

Time taken for callusing of wounds of different sizes : A total of 367 wounds were recorded on 250 trees assessed in five different felling coupes (Table 1). Breadth of each wound was noted and based on callus growth of app. 2 cm per year on both sides of the wounds along the stem (Table 4), expected time taken for callusing of wounds of different sizes was calculated. The data are given in Table 5.

Table 4

Extent of callusing in wounds of different ages.

Age of the wound	Trees assessed (No.)	Width of callus growth (cm)			Average callus growth per year (cm)
		Max.	Min	Average	
7	31	11	5	7.1	1.01
4	27	7	2	3.8	0.95
1	10	1.5	1.0	1.29	1.29
		Average of all trees			1.38

Table 5

Expected time for callusing of wounds of different sizes.

Locality	Year of felling	Number of wounds expected to get callused during different years					Total
		0-5 years	6-10 years	11-15 years	16-20 years	More than 20 years	
Chhichhar block Compartment 4	1984	12	33	20	9	8	82
Sidhpur Compt. 2	1982	9	13	12	10	10	54
Chhichhar Compt. 1	1981	9	19	10	3	3	44
Sidhpur Compt. 3	1981	15	19	15	13	16	75
Peogan Compt. 1	1979	5	43	23	14	27	112
Total		47	127	80	49	64	367

The data in Table 5 above indicate that 193 wounds (52 6 per cent of total wounds) will take more than 10 years out of which 64 wounds (17.4 per cent of total wounds) more than 20 years to callus over and hence will remain exposed to attack of fungi for long periods. The risk of establishment of both trunk-rot and root and butt-rot in wounded trees, is therefore, very high.

Conclusions

Trunk-rot is a progressive decay and once established in the tree, the trunk-rot fungi continue to decay the heartwood without any visible symptoms on the tree. Root and butt-rot pathogens, on the other hand, decay the roots and affected trees may be killed outright or may be uprooted during storms when more than 50 per cent of the root system is decayed by the fungi. Root-rot fungi spread through contact between diseased and healthy roots. Infected plants will be thus potentially dangerous to adjoining healthy trees. Wounding of standing trees by rolling of logs in felling coupes thus poses serious threat to the health of coniferous forests. The practice of rolling of logs after felling along the hill slopes should, therefore, be discontinued and other methods of collecting the billets from hill tops either through manual labour or with the help of ropeways should be adopted.

SUMMARY

Field investigations conducted in five felling coupes of Rampur and Kotgarh Forest Divisions (Himachal Pradesh) during 1985 and 1986 showed that out of 250 trees assessed, 77.2 per cent were wounded by rolling of billets after felling along hill slopes for their subsequent collection at road side. Fungal decay had established on 49.5 per cent of a total of 367 wounds and was 1 cm and more in depth in 54.6 per cent of infected wounds. Incidence of wounding on trunk and root and butt regions was more or less same. Three types of fungi namely sap rot fungi (confined to dead sapwood), trunk-rot fungi and root and butt-rot fungi

were detected on the infected wounds. *Polyporus schweinitzii* and *Fomes geotropus* were indentified as trunk-rot fungi and *Heterobasidion annosum* and *Armillariella mellea* as root-rot pathogens. Field investigations indicated that out of a total of 367 wounds on 250 assessed trees, 193 wounds would take more than 10 years, out of which 64 will take more than 10 years to get callused over. The risk of their being colonized by trunk and root-rot pathogens would thus remain very high.

पातन खण्डों में लट्ठों को लुढ़काना—शकुधर वनों का संभावी रोगोत्पादक खतरा

सुजान सिंह व पी०सी० पाण्डेय

सारांश

1985 से 1986 के दौरान रामपुर और कोटगढ़ वन मण्डलों (हिमाचल प्रदेश) में पांच पातन खण्डों में किए गए क्षेत्र अन्वेषणों से पता चला कि आगणित किए गए 250 वृक्षों में से 77.2% वृक्ष पहाड़ी ढलानों पर लकड़ी के कुन्दों को लुढ़काने और बाद में उन्हें सड़क किनारे एकत्रित करने के कारण क्षत हुए। इनमें से 367 क्षतिप्राप्तों में से 49.5% पर कवक क्षयण पक्का हो चुका था और संक्रमित घावों में 54.6% पर घाव की गहराई 1 सेमी० से अधिक थी। तने, जड़ों तथा मुन्ड पर घाव का आपात लगभग यही था। तीन प्रकार के कवक अर्थात रस अपक्षथण कवक (मृत रसकाष्ठ में ही होता है) तना अपक्षयण कवक तना जड़ और मुण्ड कवक संक्रमित घावों पर देखे गऐ। *पोलीपोरस श्वायनिटजोआई* और *फोमेस जिओट्रोपस* तथा अपक्षयण कवकों हेटेरोबेसिडियन एनोसम व *आर्मीलेरियेल्ला मेलिया* जड़ अपक्षयण रोगकारक के रूप में पहचाने गए। क्षेत्र अन्वेषणों से पता चला कि आकलित वृक्षों के कुल 367 घावों में से 193 घावों को पुरने में 10 वर्ष से अधिक लगेंगे। इनसे 64 को पुरने में 20 वर्ष से भी अधिक लगेंगे। इस प्रकार उन पर तना और जड़ अपक्षयण रोगकारकों की वस्ती बन जाने का खतरा बहुत अधिक है।

References

Shigo, A.L. (1972). Succession of micro-organism and patterns of discolouration and decay after wounding in red oak and white oak. *Phytopathology* **62** : 256-159.

Sujan Singh & R.K. Tivari (1970). Role of a precursor fungus in decay in standing teak. *Indian For.*, **96** (12) : 874-876.

PHENOLOGICAL ASPECT OF MADHAULIA FOREST, GORAKHPUR

A.A. ANSARI*

Botany Department, Gorakhpur University, Gorakhpur (India)

Introduction

The germination, vegetative growth, foliation and defoliation, flowering and fruiting of plants in relation to time period are some of the important aspects of phenology. Blatter (1906-1907), Krishnaswamy & Mathuda (1954), Gupta (1961 & 1967), Kaul & Raina (1980) and Dar & Kachroo (1983) made certain phenological observations of the various parts of India. The objective of the present study is to furnish phenological calendar during the solar year i.e. number of plants flowering in each month to compare with the phenology of woody and herbaceous species against the changing weather and season.

Geographical Location, Topography, Soil and Climate

Gorakhpur district is situated in the eastern part of Uttar Pradesh between latitudes 26°42′ and 27°25′N and longitudes 83°13′ and 83°52′E. Madhaulia forest lies 91 km north-west of Gorakhpur city in Maharajganj tehsil and is very close to foot-hills of Himalayas. The total area is about 10,023.26 ha. The average altitude of the area is 99.77 m. The land surface is apparently a level tract sloping gently from north-west to south-east. Moreover, the area is characterised by the river "Pyas" (Jharai) and Malav "nala" (rivulet) which flow from north-east to south-east. Besides, there are many "tals" (Gulgulia, Kodia and Murdaia), small "nalas" and low-lying areas which remain inundated during and for sometimes after the rains, submerging most part of the forest during this period.

The soil is composed of Gangetic alluvium. In most places the soil is of close texture but the banks of "nalas" and river have soil of a coarser nature as the heavier silt gets deposited there. The sub-soil composed mostly of hard clay is poorly aerated with little thickness of loam at the surface. Beneath this, at depths varying from a few to 6 m or more, there is usually a deposit of pure sand (Tiwari, 1965).

The climate of Gorakhpur is of monsoon type. Based on general meteorological conditions of the district, the year may broadly be divided into rainy, winter and summer seasons. Besides, there are two short interludes, which mark the transition from one season to another. The data were obtained from the Sugarcane Research Station, Gorakhpur.

Rainy season starts from mid-June and extends upto mid-October. Out of about 1210.55 mm average total annual rainfall nearly 92.1% is received during this season alone. The months of July and August are wettest. Mean relative humidity is about

---

* Presently at Botanical Survey of India. Pauri Garhwal (U.P.)

84.80% during this period, mean daily maximum and minimum temperatures are 27.55°C and 22.80°C respectively. Mean diurnal fluctuation in temperature is 4 75°C The diurnal fluctuation in temperature is slightly higher during June and September than in July and August. The period from mid-October and mid-November shows transition from rainy to winter season The rains are almost over during this phase. The important feature of this period is a wide fluctuation in day and night temperature as compared to that of rainy season. Mean relative humidity is 78.89%, which is a bit lower than that in rainy season. Mean daily maximum and minimum temperatures are 27.99°C and 16.46°C respectively. Mean diurnal fluctuation of the temperature 11.53°C is more than two times of that obtained during rainy season.

Winter season follows the transition period and extends from mid-November to February. It is characterised by very low temperature, large diurnal range of temperature fluctuations, low relative humidity and light north-westerly or westerly winds. The easterly wind suddenly appears in the district from the last week of December to second or third week of January and brings about an average of 23.96 mm rainfall. The coldest months of this season are December and January when night temperature occasionally reaches the freezing point causing frosts. There are generally heavy dew fall and morning mists. In December and January, the weather is sometimes disturbed by cold waves which lasts for four or five days. The mean daily maximum and minimum temperatures are 23.22°C and 10.60°C respectively. The mean diurnal fluctuations of temperature as compared to that of other seasons is quite high being 12.62°C. Mean relative humidity is 81.30%. March is the mild warm month forming a transition period between the cold and hot seasons. There is a gradual rise in temperature and decrease in barometric pressure. Mean relative humidity is low, being 68.43% and mean daily maximum and minimum temperatures are 30.25°C and 16.08°C respectively. The diurnalflu ctuation in temperature during this period is 14.17°C. The average rainfall is about 14.93 mm.

Summer season commences from April and lasts upto the middle of June. It is characterized by high temperature and practically no rainfall. Occasional showers may fall in late May or first week of June. Mean relative humidity is very low being 58.05%. Mean daily maximum and minimum temperatures are 35.24°C and 24.53°C respectively. The diurnal fluctuation of temperature is 10.71°C. In the later part of May and early June, the temperature rises to its maximum.

Observations and Methods

The present observations are the result of three years (1974-76)intensive investigation of the area by visiting different pockets in a pre-planned way at regular intervals. Particular care was paid togather information on correct flowering periods and to know the different kinds of plants flowering in various seasons. The vegetation of the forest is of moist-deciduous type with a few exceptionally evergreen and semi-evergreen species. Most of the woody plants shed their leaves at the beginning of the winter while others during the summer season. During rainy season the area is densely and thickly covered with vegetation i.e. maximum number of annuals and biennials come up during this period. In winter the ground remains almost devoid of herbaceous plants except very few hardier ones, which flourish during this period.

The factors governing the phenology are both internal and external. The internal factors or inherited traits are the outcome of the development of the species through the ages and determine the broad pattern of its phenological behaviour even when it grows in places with very dissimilar climatic conditions. The external factors modify the effect of internal forces. The variations in the phenological behaviour of the same species under different climatic conditions and the fluctuations observed from year to year in the same locality are due to such factors and few species do show the rhythmic periodicity in behaviour of their flowering with respect to the yearly periodicity. Among the external factors may be listed rainfall, temperature, humidity, soil moisture at different depths, light intensity and its duration, reserve food materials etc.

Of all the phenological aspects, the most important ones are flowering and fruiting. Since the fruit formation is always preceded by the flowering, the periodicity of flowering will give relevant information about the fruiting period and will thus be helpful in determining the frequency of seed setting and the proper time of its collection. As such, under the present observations on the seasonal aspect of the flora emphasis has been laid on the flowering periods of plants.

Results

Table 1 shows the number of woody and herbaceous plants (grouped according to their different habits) flowering in each month of the year. A list of flowering periods of some of the important species has been given in Table 2 where sign '+' indicates flowering time and '– ' indicates absence. The total number of herbaceous and woody plants flowering in each month of the year has been plotted against monthly rainfall and temperature (Fig. 1) in order to study the correlation of the flowering periods with these two major climatic factors. The comparison of the temperature curve shows that the herbaceous plants record maximum flowering during July-September, when the temperature is decreasing while the woody plants record maximum flowering during March-April, when the temperature is increasing and is high as compared to other months. The flowering in woody plants is minimum during November-January, when the temperature is low and starts increasing from February reaching its maximum in April and May after which it diminishes and again record a slight rise in August - the period of maximum flowering of herbaceous plants. The comparison of the rainfall curve indicates that flowering period of the herbaceous plants is maximum during July-September, when the precipitation is high, while the woody plants show maximum flowering during March-April, when the rainfall is low. The flowering in herbaceous plants is minimum during April-May, when the temperature is high and starts increasing from July, reaching its maximum in August, after which there is a gradual decrease till November.

Discussion

With the leaf-fall in winter and

Table 1

Number of woody and herbaceous plants flowering in each month of the year

Months	Woody					Herbaceous					
	Tress	Erect shrubs	Climbing shrubs	Parasitic shrubs	Total	Erect herbs or under shrubs	Prostrate herbs	Climbing herbs	Parasitic herbs	Aquatics	Total
January	8	2	1	—	11	7	5	—	1	1	14
February	13	6	5	—	24	23	8	—	—	—	31
March	30	2	5	—	37	24	6	2	—	—	32
April	30	3	6	—	39	7	5	—	—	2	14
May	11	3	3	—	17	9	1	—	—	1	11
June	5	4	5	—	14	16	4	—	—	—	22
July	5	8	7	—	20	51	16	4	—	3	74
August	9	11	7	—	27	69	20	10	—	2	101
September	7	8	7	—	22	56	10	10	1	8	85
October	—	4	10	1	15	34	6	5	—	6	51
November	3	2	5	1	11	11	4	1	—	1	17
December	3	4	—	—	7	19	9	—	—	2	30
					244						482

Sign— '—' indicates absence.

summer in woody species the foliar and floral bud primordia are formed which of course remain dormant till the onset of the following season. The seeds of majority of herbaceous species though shed in rainy season with a few proportion in winter and summer seasons, usually do not germinate until the next favourable season (Longman & Jenik, 1974). The woody species need cold temperature during winter months (23.22°C to 10.60°C) short day length for sprouting of foliar and floral buds, which is required to break this dormancy. During summer months the woody species show maximum flowering the increasing temperature from March to April and long photoperiod are the important factors for the development of sexual organs. The maximum flowering in herbaceous species does not coincide exactly with the maximum of rainfall in July but with a low rainfall in August. The reason may be explained as to that herbaceous plants (except those with bulbs, tubes or rhizomes) have no storage

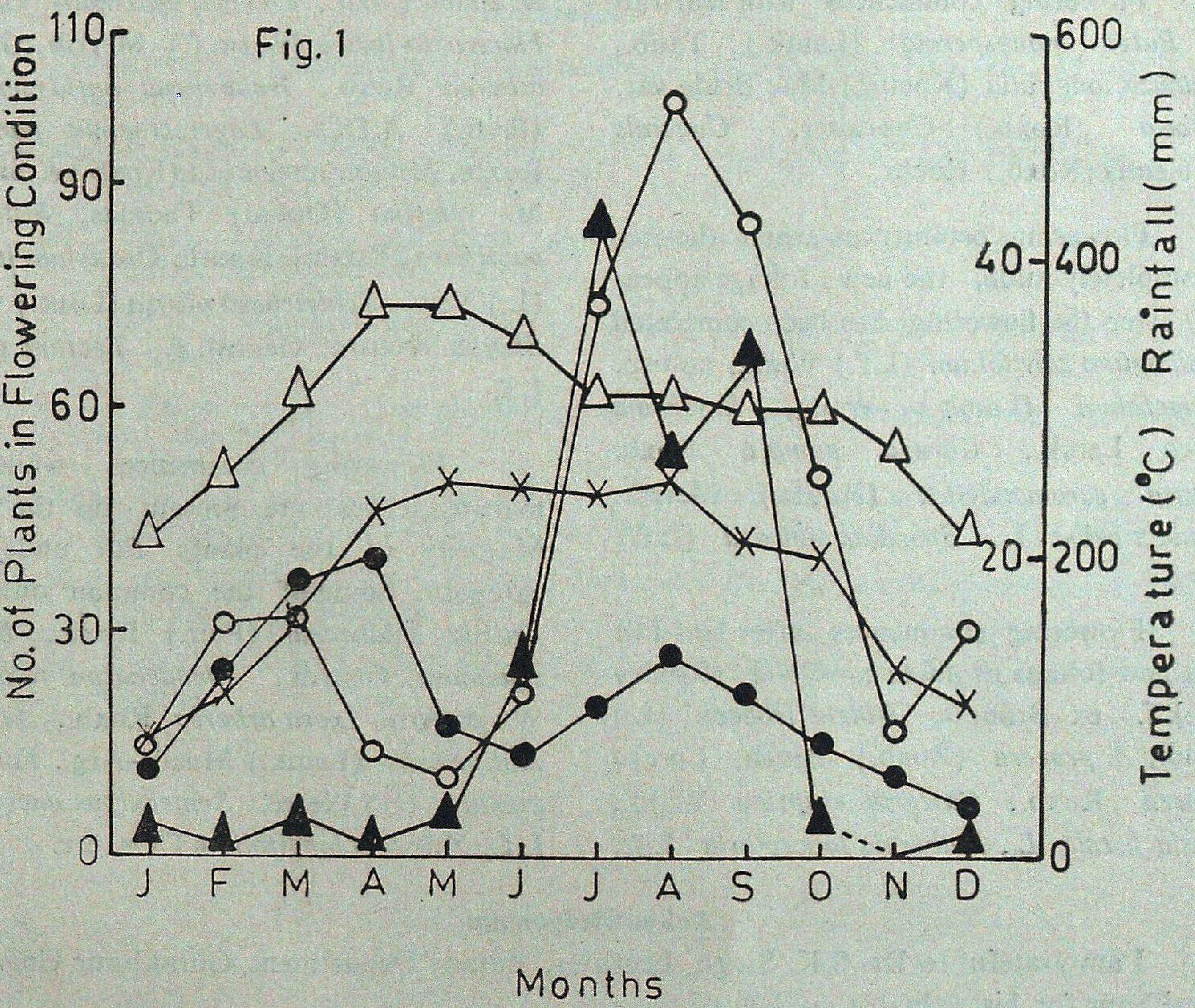
Table 2

Flowering periods of some of the important plants

Name of species	Flowering time											
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Abrus precatorius L.	—	—	—	—	—	—	—	+	+	+	—	—
Acacia catechu (L.f.) Willd.	+	+	—	—	—	—	—	+	+	+	+	+
Adhatoda zeylanica Medic.	—	+	+	+	—	—	—	—	—	—	—	—
Andrographis paniculata (Burm. f.) Wall. ex Ness	—	—	—	—	—	—	—	—	+	+	+	+
Bacopa monnieri (L.) Pennell	—	—	—	—	—	—	+	+	+	+	+	+
Butea monosperma (Lamk.) Taub.	—	—	+	+	+	+	+	—	—	—	—	—
Costus speciosus (Koenig) Smith	—	—	—	—	—	—	—	+	+	+	—	—
Dalbergia sisso Roxb.	—	+	+	+	+	+	+	+	—	—	—	—
Gloriosa superba L.	—	—	—	—	—	—	—	+	+	+	+	—
Holarrhena antidysenterica (Roth) A.DC.	—	—	—	—	+	+	+	—	—	—	—	—
Piper longum L.	—	—	—	—	—	—	—	—	+	+	+	—
Pongamia pinnata (L.) Pierre	—	—	+	+	+	+	+	+	+	+	+	—
Rauvolfia serpentina (L.) Benth. ex Kurz	+	—	—	—	+	+	+	+	+	+	+	+
Bombax ceiba L.	—	+	+	+	+	—	—	—	—	—	—	—
Shorea robusta Gaertn. f.	—	—	+	+	+	+	—	—	—	—	—	—
Tectona grandis L.f.	—	—	—	—	—	—	—	+	+	+	+	+
Woodfordia fruticosa (L.) Kurz	—	+	+	+	+	+	—	—	—	—	—	—

'+' indicates flowering time, '—' indicates absence.

Fig. 1



Climate of Gorakhpur on the average of three years, 1974-76 (data obtained from Sugarcane Research Station, Gorakhpur) and total number of herbaceous and woody plants flowering in each month of the year. Rainfall—solid triangle; Maximum temperature—open triangle; Minimum temperature—cross; Woody plants—solid circle; Herbaceous plants—open circle.

of reserve material which enables them to develop flowers but that they have to grow first the vegetative organs by means of which they are enabled to produce reproductive organs. This 'periodic difference' in the flowering of various species gives a seasonal aspect to the vegetation. Thus, the variable phenological behaviours are due to different environmental conditions.

Further, it can also be concluded that the seeds and buds of various species probably require a long resting period besides the effect of different rainfall and temperature ranges for the initiation of their growth. This 'periodic difference' in the flowering of various species gives a seasonal aspect to the vegetation. Thus, the variable phenological behaviours are due to different environmental conditions.

Besides, some interesting observations have also been made regarding the flowering of certain important woody species and their foliage condition. These have been correlated as follows :

Flowering commences with leaf-fall in *Butea monosperma* (Lamk.) Taub., *Madhuca longifolia* (Koenig) Mac Bride var. *latifolia* (Roxb.) Chevalier, *Ougeinia oojeinensis* (Roxb.) Hochr.

Flowering commences when the tree is completely nude, the new foliage appear only after the flowering has been completed in *Alangium salvifolium* (L.f.) Wang, sub-sp. *decapetalum* (Lamk.) Wang, *Erythrina indica* Lamk., *Garuga pinnata* Roxb. *Lannea coromandelica* (Houtt.) Merrill, *Bombax ceiba* L., *Spondias pinnata* (L.f.) Kurz.

Flowering commences after leaf-fall with new foliage in *Adina cordifolia* (Roxb.) Hook.f. ex Brandis, *Albizia lebbeck* (L.) Willd., *A. procera* (Roxb.) Benth, *Careya arborea* Roxb., *Casearia elliptica* Willd., *Cassia fistula* L., *Dalbergia lanceolaria* L.f., *D. sissoo* Roxb., *Emblica officinalis* Gaertn., *Flacourtia indica* (Burm.f.) Merrill, *Gmelina arborea* Roxb., *Holarrhena antidysenterica* (Roth) A.DC., *Lagerstroemia parviflora* Roxb., *Miliusa tomentosa* (Roxb.) J. Sinclair, *M. velutina* (Dunal) Thomas, *Mitragyna parviflora* (Roxb.) Kunth, *Oroxylum indicum* (L.) Vent., *Schleichera oleosa* (Lour.) Oken., *Shorea robusta* Gaernt. f., *Tectona grandis* L f.

Flowering commences while the mature leaves are present on the plant. Majority of the plants fall under this category. Some of the common ones are: *Ardisia solanacea* (Poir.) Roxb., *Bridelia squamosa* Gehrm., *Eleodendron roxburghii* Wt. & Arn., *Ixora arborea* Roxb., *Mallotus philippensis* (Lamk.) Muell.-Arg., *Pongamia pinnata* (L.) Pierre, *Semecarpus anacardium* L.f., *Xylosma longifolium* Clos. etc.

Acknowledgemant

I am grateful to Dr. S.K. Singh, Lecturer, Botany Department, Gorakhpur University, Gorakhpur for his valuable guidance.

SUMMARY

The phenological behaviours of 726 angiospermic species recorded from Madhaulia forest have been studied. An attempt has been made to study the influence of two major climatic factors viz. rainfall and temperature on flowering periods of woody and herbaceous plants. The correlation indicates that flowering period of woody plants is maximum during March-April, while herbaceous plants showed maximum flowering during July-September.

मढौलिया वन, गोरखपुर का ऋतुजैविकीय पक्ष

ए०ए० अंसारी

सारांश

मढौलिया वनों की 726 संवृत बीजा जातियों के ऋतुजैविकीय व्यवहार का अध्ययन किया गया। इन पर दो मुख्य जलवायु कारकों अर्थात वर्षा और तापमान का काष्ठीय और शाकीय पादपों का पुष्पन की अवधि पर प्रभाव के अध्ययन का प्रयास किया गया है। इस सहसम्बन्ध से संकेत मिला है कि काष्ठीय पादपों की पुष्पन अवधि मार्च-अप्रैल में अधिकतम रहती है जब कि शाकीय पादपों पर अधिकतम पुष्पन जुलाई-सितम्बर के बीच अधिक होता है।

References

Blatter, E. (1906-1907). Flowering season and climate. *J. Bomby Nat. Hist. Soc.* **17** : 334-50; 697-708

Dar, G.H. and P. Kachroo (1983). Phenology of the vegetation of Ganderbal, Kashmir. *Trop Plant. Sci. Res.* **1** (3) : 231-34.

Gupta, R.K. (1961). Climatic conditions and flowering season in Outer Himalaya at Nainital. *Indian For* , **87** : 189-193.

....................(1967). *Seasonal flowers of the Indian Summer Resorts Mussoorie Hills*, New Delhi.

Kaul, V. and R. Raina (1980). The phenology of woody angiosperms in Srinagar. *Indian For.*, **106** (2) : 94-101.

Krishnaswamy, V.S. and C.S. Mathuda (1954). Phenological behaviour of a few forest species at New Forest, Dehra Dun.' *Indian For.*, **80** (3) : 124-53; (4) : 187-206.

Longman, K.A. and J. Jenik (1974). *Tropical Forest and its Environment*. Lowe and Brydone Ltd., Thatford Norfolk.

Tiwari, K.M. (1965). *Working Plan for the Gorakhpur Forest Division*, Uttar Pradesh, Nainital.

BIONOMICS AND CONTROL OF TENDU DEFOLIATOR *HYPOCALA ROSTRATA* L. (LEPIDOPTERA : NOCTUIDAE)

SUSHIL KUMAR, LALJI PRASAD* AND H.R. KHAN
Forest Entomology Branch,
Forest Research Institute, Dehra Dun (India)

Introduction

Tendu *Diospyros melanoxylon* Roxb. is an important tree species in the states of Madhya Pradesh, Maharashtra and Orissa. Its leaves are used for manufacture of Bidis. The tree suffers considerably by the leaf defoliator, *Hypocala rostrata* L. (Lepidoptera : Noctuidae), particularly during post monsoon season. Hampson (1894) and Gardner (1941) have described adult and larval stages of the insect respectively. However, its biology has not so far been studied. In the present paper, therefore, the biology of *H. rostrata* is reported. The effect of two organophosphorous insecticides namely Nuvan and Monocrotophos on the larvae has also been tested in a bid to find out suitable control of the pest.

Materials and Methods

Laboratory reared adults were released into the chimney cages. Oviposition of the adults was observed on the leaves provided. Fresh small twigs with leaves were provided daily in the cages and the leaves with eggs were kept separately for observing the hatching of the eggs. A record of oviposition, fecundity, incubation period, percentage of hatching, larval period, pupation mating, sex-ratio and longivity of both the sexes was maintained. Males had anal brush and tapering abdomen. A few moths were dissected and total eggs were counted. Leaves of nine tree species were provided as a food to third instar larvae to test the host-range. An attempt was made to find out the parasite complex of the pest by collecting the 2nd and 3rd instar larvae from field in September 1984 and rearing them in laboratory.

To find out the extent of damage to tendu leaves caused by this insect, 25 bushes from each of the four different plots having at least 100 bush in each plot were selected at random. Total leaves and leaves damaged by the larvae of *H. rostrata* during post monsoon season were counted and percentage of damage calculated. Observations on the monthly abundance of the larval population during 1984-85 were also taken.

Two organophosphorous insecticides viz , Monocrotophos (36 EC) and Nuvan (100) in three concentrations (0.01%, 0.02% and 0.05%) were tested under laboratory condition against 3rd instar larvae. Fresh leaves were sprayed with the aforesaid insecticides. The insecticide treated leaves after drying under fan, were provided to larvae for feeding. Control was sprayed with tap water. Each treatment was replicated thrice.

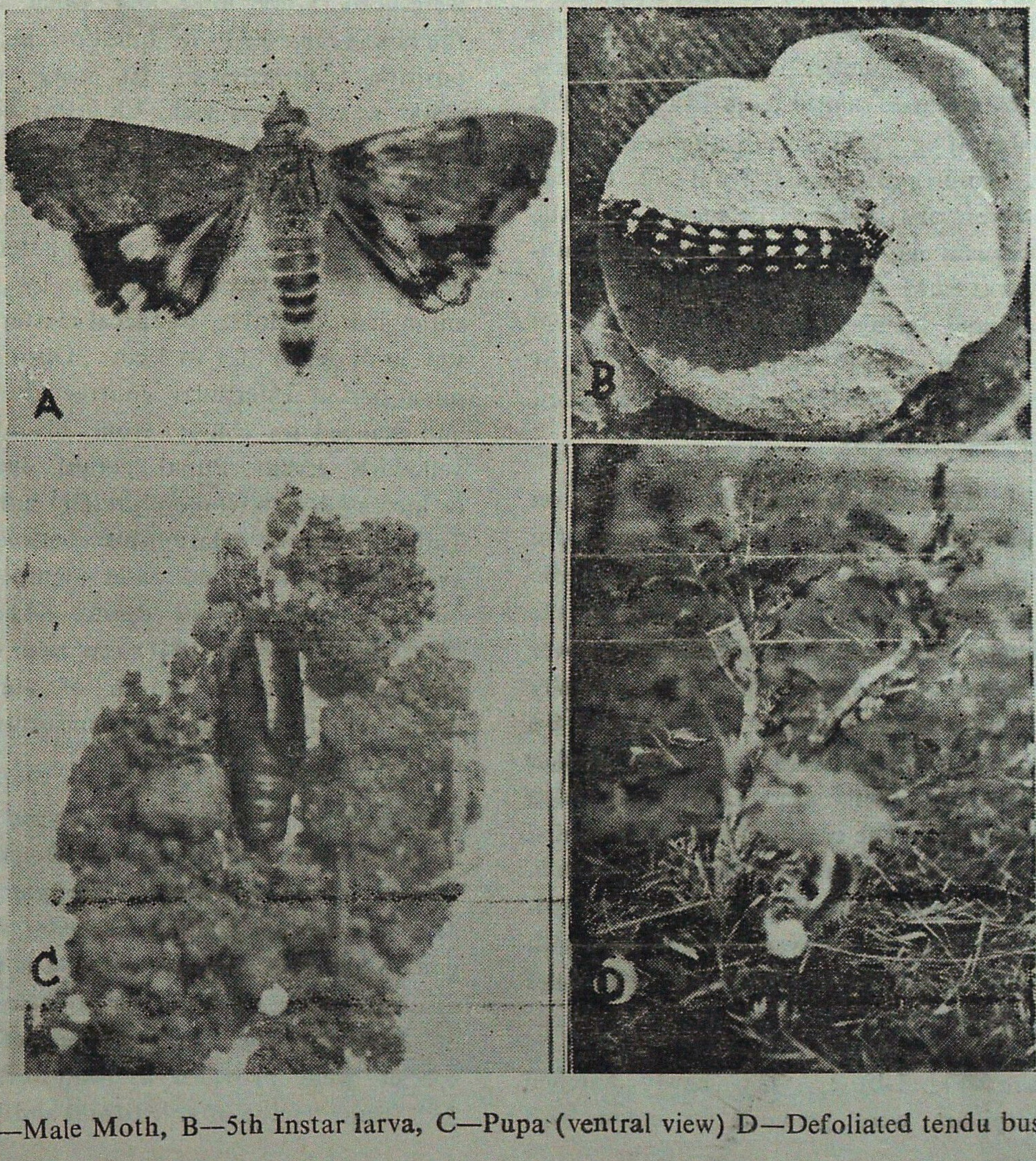
---

* Disease Insect Survey, Forest Research Institute, Dehra Dun.

Results and Discussion

Adult (Fig. 1-a) : Moth's emergence mostly takes place at night till early hours of morning. The females are bigger than the male. The wing expansion and body length of the male measured 2.77 ± 0.23, 1.44 ± 0.14 cm and a female 3.07 ± 0.34 × 1.55 ± 0 13 cm (n=10). The females lived longer than the males. The average life span of male moth fed on glucose diet was 11.09 ± 8.52 days (n = 22 whereas the females lived for 11.58 ± 6.90 days (n = 24). The maximum life span

Fig. 1



A—Male Moth, B—5th Instar larva, C—Pupa (ventral view) D—Defoliated tendu bush.

of females and males was recorded 27 and 25 days respectively. The males outnumbered the females On an average, 53.92% of the emerged moths were male (n=55) while the females were 46.08% (n=47). Mating which mostly occurs at night is end to end facing the heads in opposite directions.

Oviposition : Females take an average of 3±0.71 days (n=13) for its first oviposition and oviposition period was recorded upto 6 days. The number of eggs laid on first day by a female ranged from 14 to 63. The number of eggs laid during the second day was more and ranged from 72 to 112. However, the number decreased in the subsequent egg layings The average fecundity was 52.29 ± 32.53 per female per day (n=4) and during whole life 199.5 ± 23 98 (n=4). In gravid moths an average of 343.5 ± 39.05 (n=4) egg were counted when they were dissected.

Egg : The eggs are mainly deposited on ventral side of the leaves, but few eggs were also observed on the dorsal side of the leaves, twigs, plastic tube, the wall of the chimney cages and on the muslin cloth cover the mouth of the cages. Eggs were generally laid singly but sometimes in batches of 4-6 in a row. The eggs were ovoid. The chorion in the egg shell was rigid and with sculpturing. The creamy fresh eggs turned dark after one and a half days of oviposition. Each egg measured 0.57 ⊢ 0.03 mm (n=10) The hatching period averaged 2.54 days with a range of 2-3 days. Hatching percentage was 86.50.

Larva (Fig. 1-b) : The newly hatched caterpillars were greenish in colour with blackish head. The colour changed from greenish to pinkish red after 4-5 days of feeding at 3rd instar. White and yellow bands began to appear at dorsoventral position. At 5th instar, reddish or greenish larvae changed into greenish black with yellow and white round spots on the dorsolateral position. Skin of the larvae remained smooth throughout. There are five larval instars and the mature larvae were upto 35 mm long and when at rest, the larvae remained in question mark (?) position Duration of Ist instar to 3rd instar was 2-3 days each, 4th instar 2-4 days and 5th instar. 3-5 days. Total larval period in July and August was 18 ± 1.41 (n=23).

Pupa (Fig. 1-c) : The larvae pupated with or without a covering made by saliva entangled in litter or faecal matter in the soil at a depth of 1 to 3 cm. During prepupal period caterpillar contracted in size and changed its colour from blackish to yellowish green. Pupal period decreased or increased with temperature and humidity. Table 1 shows relationship between the average pupal period and temperature, humidity and rainfall during April to November. Beeson (1941) reported 8 days pupal period in the month of July and August which more or less conforms with our data

Host range : Nine plant species viz., *Acacia auriculaeformis*, *Cassia siamea*, *Butea monosperma*, *Ceiba pentandra*, *Dalbergia sissoo*, *Madhuca indica*, *Lantana camera*, *Tectona grandis* and *Vitex negundo* which are normal associates of tendu were tested as a source of food for the pest. Leaves of these species were provided as food to 2nd and 3rd instar larvae of *H. rostrata* and kept in

Table 1

Pupal period of Hypocala rostrata in various months with relation to temperature, humidity and rainfall

Months	Pupal period	Temp. (°C)		Relative humidity		Rainfall (mm)
		Max.	Min	Max.	Min.	
April	6.17±0.41 (n=6)	38.98	21.2	47.80	14.30	14.00
May	7.43±0.53 (n=7)	38.25	27.93	31.25	14.5	0
June	8.08±1.00 (n=12)	36.43	25.78	73.25	46.25	24.85
July	7.74±0.73 (n=13)	31.12	24.28	89.40	70.40	89.96
August	9.46±1.05 (n=13)	27.50	23.35	95.00	86.25	204.75
September	9.38±1.06 (n=8)	29.80	22.18	91.05	64.00	37.50
October	11±1.49 (n=10)	31.16	17.20	86.40	36.80	0.80
November	15.89±4.43 (n=9)	27.48	0.50	85.75	24.00	0

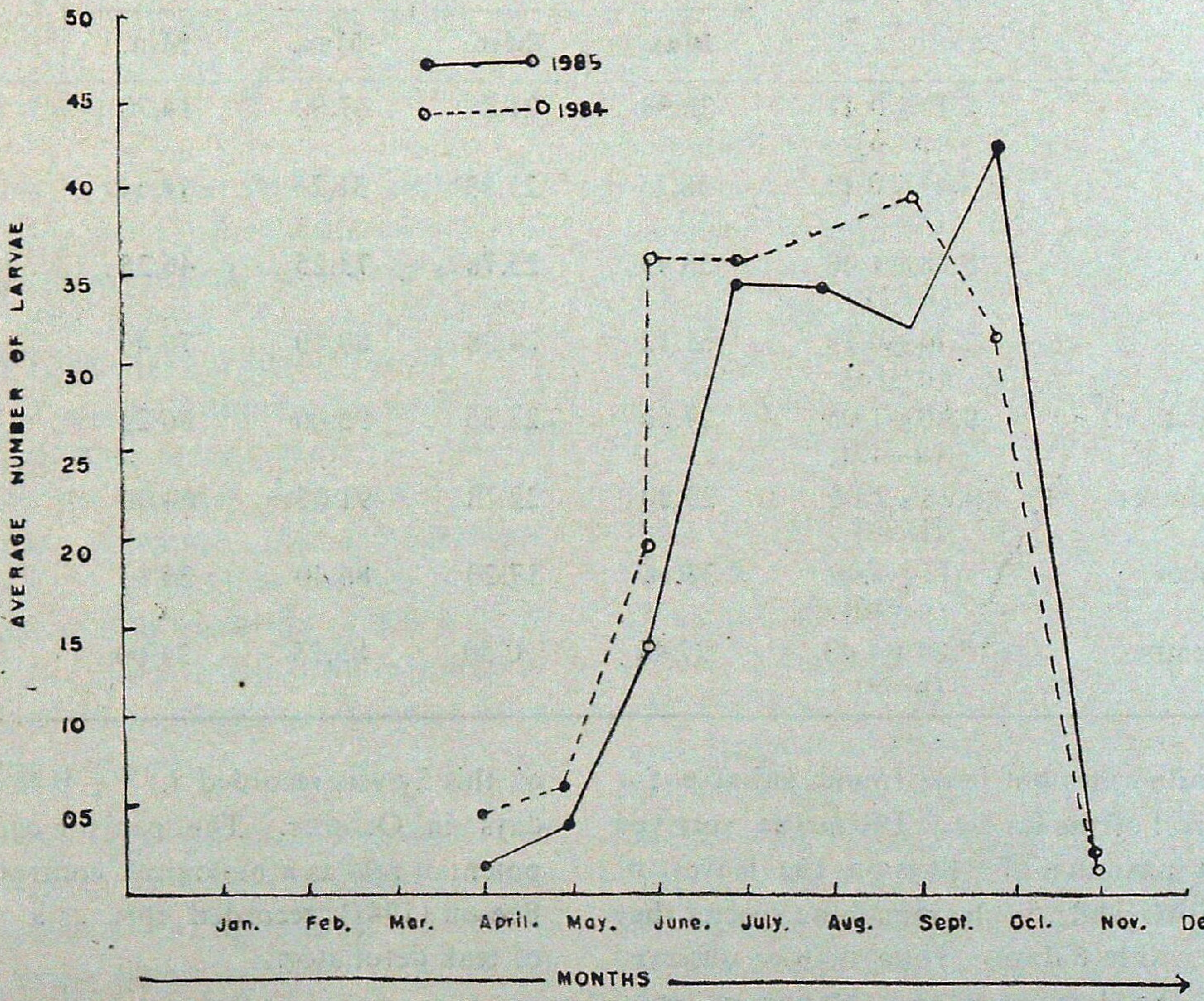
separate cages but none found suitable for survival of the larvae. The larvae survived for a maximum of 9 days on the leaves of *D. sissoo* while on the remaining species they died within 6 days. Thus it was observed that the larvae can survive only on tendu leaves.

Enemy complex: During field survey in October, 1984, 22.59% larvae were found to be attacked by a parasite, *Winthemia albiceps* Malloch (Diptera-Tachinidae). The fly glued its eggs on the body of larvae which on hatching, bore into the larval tissue and lived as a parasite. Full grown maggots (generally one and often two from single larvae) come out after rupturing the body wall of 5th instar larvae and pupate on the outer side within 12 hours. Pupal period of this fly was recorded 8.57 ± 0.98 (n = 7) days in October. The parasite can play a potential role as a biological control agent. Beeson (1941) recorded this as a parasite of teak defoliator.

Nature and extent of damage (Fig. 1-d) : The first and second instar larvae feed on the ventral epidermis and soft palisade tissue between two leaves glued together but later instars can feed on the individual leaves and can eat every part except mid-rib and large veins. Heavy attack causes large scale defoliation of tendu bushes which make the leaves of new season unfit as bidi wrapper. On an average 42.19% leaves of post-monsoon period were found damaged by this insect in September, 1985.

Seasonal abundance of larvae (Fig. 2) : The larvae started appearing in the field in the month of April. All the stages of the pest were available during June to October. The insect was not seen in any of its active stage from December to March. During October, 1984 larvae population was highest (Fig. 2).

Fig. 2



Seasonal abundance of larvae of *Hypocala rostrata* in the year 1984 and 1985.

Table 2

Mortality of H. rostrata after feeding on insecticides treated leaves

Insecticides	Concentrations (%)	Mortality of larvae (%)	
		After 12 hrs.	After 24 hrs.
Monocrotophos 36 EC	0.01	63.33	73.33
	0.02	86.67	93.33
	0.05	90.00	100.00
Nuvan 100	0.01	56.67	66.67
	0.02	83.33	90.00
	0.03	93.33	100.00

Control

In laboratory conditions, Nuvan was found more effective than Monocrotophos (Table 2). However both the insecticides are quite effective even at very low dose (0.01%) but to control the insect in field conditions, Monocrotophos may be recommended due to its rapid degradibility and less persistant nature. Intensive field trials are under investigation.

SUMMARY

Biology of tendu defoliator *Hypocala rostrata* was studied. Larvae started to appear in the month of April and highest population was recorded in the month of October, 1985. In July and August average larval period of 18 ± 1.41 days was recorded. Pupal period varied from 6.17 ± 0.41 to 15 89 ± 4 43 days in April and November respectively. Nuvan and Monocrotophos in EC formulations were found effective to control the 3rd stage larvae.

तेन्दु निष्पत्रक कीट हाइपोकेला रोस्ट्रेटा लि० (शल्किपक्षा : नौक्टुइडि) की जैवगतिकी तथा नियन्त्रण

सुशील कुमार, लालजी प्रसाद व एच०आर० खान

सारांश

तेन्दु निष्पत्रक कीट की जैविकी का अध्ययन किया गया। इसके जातक अप्रैल मास मे प्रकट होने शुरू हुए और इनकी अधिकतम सख्या अक्टूबर 1985 मे आलेखित की गई। जुलाई और अगस्त मे औसत जातक अवधि 18 ± 1 41 दिन की रही। कोशित रहने की अवधि 6.17 ± 0.41 से लगाकर 15.89 ± 4.43 दिन तक क्रमशः अप्रैल और नवम्बर मे रही। ईसी सूत्रों में बनी नूवन और मोनोकोटोफॉस तृतीय स्तर जातक के नियन्त्रण में प्रभावशाली पाई गई।

References

Beeson, C.F.C. (1941). *The Ecology and control of the Forest Insect of India and the Neighbouring Countries*. Govt. of India, New Delhi (Reprinted 1961) : 767 pp.

Gardner, J.C.M. (1941). Immature stages of Lepidoptera : Noctuidae : Hypsidae. *Indian For. Rec.* (Ent.) **8** : 253-298.

Hampson, G.F. (1894). *Fauna of British India. Moths.* Vol. II Taylor and Francis, London (Reprinted Today and Tomorrow Printers and Publishers, New Delhi) 609 pp.

IN-VITRO ANTIMICROBIAL ACTIVITY OF ESSENTIAL OIL OF NEWLY EVOLVED *EUCALYPTUS* HYBRID FRI-5.

D.C. CHAUDHARI, C.L. GOEL, R.K. SURI AND P.K. DESHMUKH*

Minor Forest Products Branch,
Forest Research Institute, Dehra Dun (India)

Introduction

A good deal of research work has been carried out on antibacterial and antifungal activity of essential oils (Nayak & Rao, 1980; Gulati & Suri, 1982). Essential oils obtained from various *Eucalyptus* spp. has also been studied for antibacterial and antifungal activities (Beylier, 1979; Kaul & Nigam, 1976; Thind, 1977; Rao & Nigam, 1978; Suri & Thind, 1978; Sampurna & Nigam, 1979; Suri, 1979; Suri *et al.*, 1979; Thind & Suri, 1979; Suri *et al.*, 1984), but no work has been carried out on antibacterial and antifungal activities of essential oil of *Eucalyptus* hybrid FRI-5 (*E. camaldulensis* × *E. tereticornis*), therefore, detailed studies on the antimicrobial efficacy of the oil has been carried out and the results obtained are discussed in this paper.

Experimental

The essential oil from the leaves of *Eucalyptus* hybrid FRI-5 (*E. camaldulensis* × *E. tereticornis*) was obtained by hydrodistillation and dried over anhydrous sodium sulphate Different dilutions of essential oil viz , 1 : 100, 1 : 250, 1 : 500 and 1:1000 were prepared using ethylene glycol as solvent. The pure oil and its aforesaid dilutions has been tested against eight bacteria (Table 1) and six fungi (Table 2). The antibacterial and antifungal activity of *Eucalyptus* hybrid FRI-5 oil was screened by filter paper disc-method reported earlier (Chaudhari, *et al.*, 1988).

The antibacterial and antifungal activities were measured in terms of inhibitory zone as an average of maximum dimension of zone inhibition around the filter paper disc in four different directions. The results are enumerated in the Tables 1 and 2.

Results and Discussions

It is apparent from Tables 1 and 2 that the essential oil of *Eucalyptus* hybird FRI-5 have maximum antibacterial and antifungal activity when tested undiluted but the activity decreases as the dilution increases.

In the case of bacteria, the pure oil showed highest inhibitory activity against *Salmonella paratyphii* (35.0 mm) and least against *Bacillus pumilus* (25.0).

In the case of fungi, the pure oil gave highest inhibitory activity against *Penicillium notatum* (36.0 mm) and least against *Epidermophyton rubrum* (26.0 mm).

---

* Department of Botany, University of Saugar, Sagar (M.P.)

Table 1

Antibacterial activity of essential oil of Eucalyptus hybrid FRI-5

Organisms*	Diameter of zone of inhibition (mm)**					
	100%	1 : 100	1 : 250	1 : 500	1 : 1000	Control
Bacillus mycoides	31.0	28.0	25.5	22.0	18.5	Inactive
B. pumilus	25.0	21.5	19.0	17.0	14.5	-do-
Esaherichia coli	30.0	27.5	25.0	22.5	18.5	-do-
Proteus vulgaris	28.0	25.5	22.0	19.5	16.5	-do-
Salmonella paratyphii	35.0	31.0	26.5	22.5	19.5	-do-
Sarcina lutea	29.5	25.5	21.0	19.0	16.0	-do-
Shigella nigesta	26.5	23.5	20.0	17.5	15.0	-do-
Staphylococcus aureus	26.0	22.5	19.5	17.0	14.5	-do-

Table 2

Antifungal activity of essential oil of Eucalyptus hybrid FRI-5

Organisms*	Diameter of zone inbibition (mm)**					
	100%	1 : 100	1 : 250	1 : 500	1 : 1000	Control
Aspergillus niger	28.0	25.0	21.5	19.0	15.5	Inactive
Candida albicans	31.0	27.5	24.5	21.0	17.0	-do-
Epidermophytonn rubrum	26.0	23.5	20.0	18.5	15.0	-do-
Malbranchea pulchella	32.0	29.0	26.0	22.0	18.5	-do-
Microsporum gypseum	27.0	24.5	21.0	18.0	15.0	-do-
Penicillium notatum	36.0	32.5	27.0	22.5	19.0	-do-

* Obtained from Department of Botany, University of Saugar, Sagar.

** Included the diameter of paper disc (12.5 mm).

SUMMARY

The essential oil obtained from the leaves of newly evolved *Eucalyptus* **hybrid FRI-5 as such and at varied dilutions viz., 1 : 100, 1 : 250, 1 : 500 and 1 : 1000 has been tested for its antimicrobial activity** *in-vitro* **against eight bacteria viz.,** *Bacillus mycoides, B. pumilus, Escherichia coli, Proteus vulgaris, Salmonella paratyphii, Sarcina lutea, Shigella nigesta, Staphylococcus aureus* **and six fungi viz.,** *Aspergillus niger, Candida albicans, Epidermophyton rubrum, Malbranchea pulchella, Microsporum, gypseum, Penicillium notatum.* **The present investigations indicate that the** *Eucalyptus* **hybrid FRI-5 essential oil has potent antifungal**

as well as antibacterial efficacy being maximum when it is undiluted The activity decreases as the dilution increase. Even at dilution of 1 : 1000 the oil has been found active against all the test organisms.

नवविकसित युकेलिप्टस हाईब्रिड एफाराई-5 के उत्पत तेल की कांच में जीवाणु विरोधी सक्रियता

डी०सी० चौधरी, सी०एल० गोयल, आर०के० सूरी व पी०के० देशमुख

सारांश

नवविकसित युकेलिप्टस हाइब्रिड, एफाराई-5 की पत्तियों का उत्पत तेल वैसा का वैसा ही तथा विभिन्न तनूकरणों में नामत—1 : 100, 1 : 250, 1 : 500 और 1 : 1000, कांच मे जीवाणु विरोधिता सक्रियता के लिए इन आठ जीवाणुओं नामत ; बैसिलस माइक्रोआयडिस, बै० प्युमिलम, ई० शेरेशिया कोलाई, पोटिअस वल्गेरिस, साल्मोनेला पैराटायफियाई, सार्सिना ल्यूटिआ, शिगेला नाइगेस्टा, स्टैफिलोकोक्कस ऑरिस और छह कवको नामत; एस्परगिलस नाइगर, कैण्डडा एल्बिकेन्स, एपिडर्मोफाटन रयुबम, मैलब्रांचआ पुल्चेल्ला, माइक्रोस्पोरम गिप्सियम, पेनिसिलियम नोटेटम के प्रात परीक्षित किए गए। प्रस्तुत अन्वेषण का सकेत है कि युकेलिप्टस हाइब्रिड एफाराई-5 के उत्पत तेल में सभावित कवक विरोधी और जीवाणु विरोधी प्रभावकरिता है जो तनूकरण न किए जाने की दशा में अधिकतम है। ज्यों-ज्यों तेल पतला होता जाता है इसकी क्रियाशीलता घटती जाती है। तनूकरण 1 : 1000 करने पर भी यह तेल सभी परीक्षित जीवों के बिरुद्ध सक्रिय पाया गया है।

References

Beylier, M.F. (1979). Bacteriostatic activity of some Australian Essential oils; *Perfumer & Flavorist International*, **4** (2) : 23-25.

Chaudhari, D.C., R.K. Suri and P.K. Deshmukh (1988). *In-vitro* antimicrobial activity of essential oil of newly evolved *Eucalyptus* hybrid FRI-4; *Indian For.*, **114** (1) : 35-38.

Gulati, N.K. and R.K. Suri (1982) Biological application of essential oils; *Indian Perfumer*, **26** (2-4) : 241.

Kaul, V.K. and S.S. Nigam (1976). Antibacterial and antifungal studies of some essential oils; *J. Res. Indian Med. Yoga and Homoe.*, **12** (3) : 132.

Nayak, M.L. and J. Tirumala Rao (1980). Antimicrobial studies of plant products : A Review; *Indian Drugs*, **17** : 257.

Rao, T.S.S. and S.S. Nigam (1978). Antibacterial study of some Indian essential oils; *Indian Perfumer*, **22** (2) : 118.

Sampurna, T. and S.S. Nigam (1979). Efficacy of some Indian essential oils against *Trichophyton mentagrophyytes*, *Malbranchea pulchella* and *Keratinophyotn terreum* at different concentrations; *Indian Drugs Pharm. Industry*, **14** (4) : 29.

Suri, R.K. (1979) *D. Phill Thesis*, Garhwal University, Srinagar, Garhwal (U.P.).

Suri, R.K and T.S. Thind (1978). Antimicrobial activity of some essential oils; *Indian Drugs & Pharm. Industry*, **13** (6) : 25-28.

Suri, R.K., S.S. Nigam and T.S. Thind (1979). *In-vitro* antimicrobial efficacy of essential oil of *Eucalyptus citriodora*; *Indian Drugs & Pharm. Industry*, **14** (3) : 35-37.

Suri, R.K., M.P Shiva and N.K Gulati (1984). Studies on utilization of *Eucalyptus* hybrid oil : *Proc. National Seminar on Chemistry, Industry and citizen* ; *26-28 Dec. 1982*; *Indian Chemical Society* (Dehra Dun Branch).

Thind, T.S. (1977). *Ph. D. Thesis*, Saugar University, Sagar (M.P.).

Thind, T.S. and R.K. Suri (1979). *In-vitro* antifungal efficacy of four essential oils; *Indian Perfumer*, **23** (2) : 138-140.

A NEW LEAF SPOT DISEASE OF *DERRIS ROBUSTA*

M.D. MEHROTRA* AND G.S. SARMA

State Forest Service College-cum-Research Centre,
Burnihat (*Assam*)

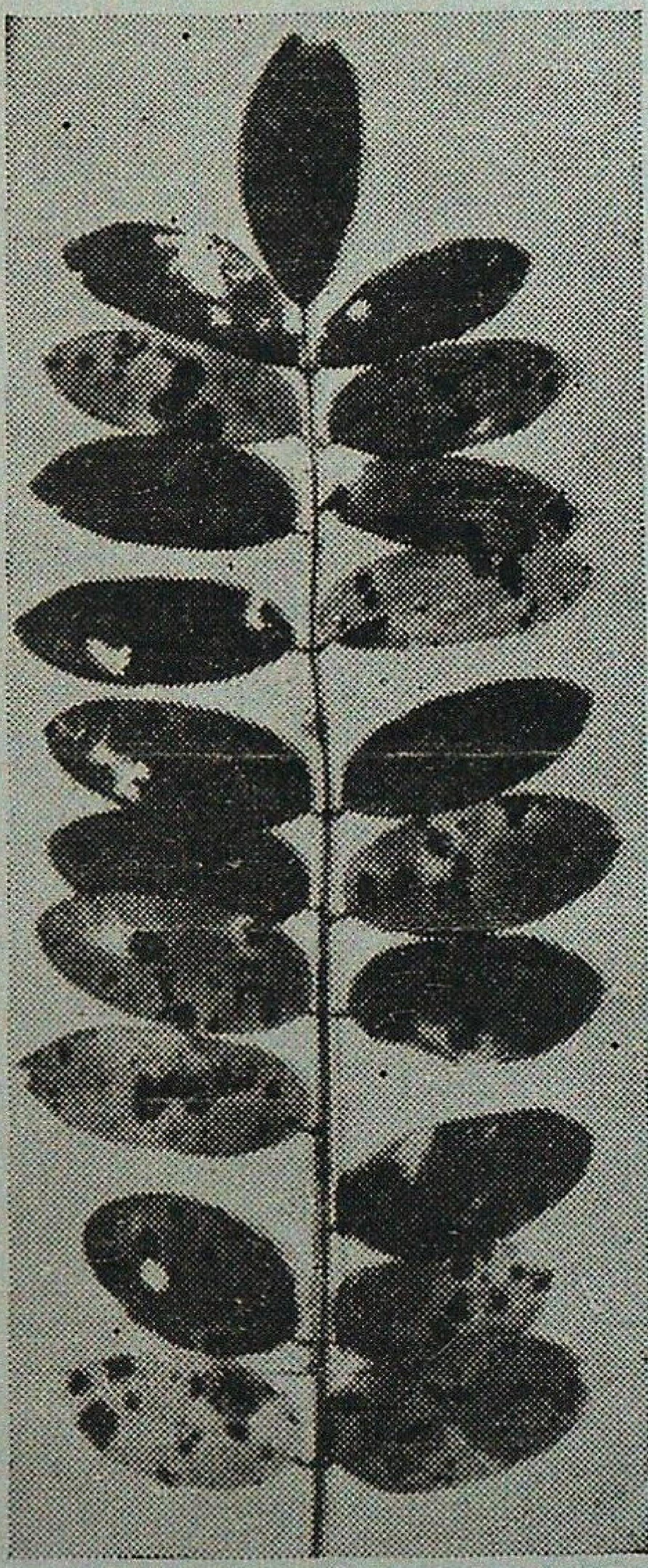
Introduction

During disease survey conducted in the forests in and around Burnihat, the authors observed a new leaf spot disease in *Derris robusta* Benth. in September-October, 1985. The pathogen was identified as *Stigmina millettiae* Ellis. The disease was widely distributed in the forests and almost all the trees, both young and old, were attacked by the pathogen. Particularly the trees growing in shade and damp locations suffered heavily and the leaves showed cent per cent infection and had more number of spots. The infection spots were usually few to many, dark brown with irregular margin and upto 6 mm in size. The neighbouring spots occasionally coalesced. On aging the spots are distinguishable into two regions, the inner grey to brown region surrounded by dark brown irregular border. The fungus developed sporodochia on the lower surface of the leaf as tiny black structures throughout the infected portion.

Material and Method

The fungus was isolated on Potato Dextrose Agar medium and the pathogenicity tests were conducted successfully by inoculating the healthy leaves which were covered with polythene bags having water soaked cotton for the purpose of maintaining the desired humidity. After 72 hours the bags were removed and the typical symptoms of the disease were developed in 7-10 days.

Fig. 1



Infection spots on *Derris robusta* caused by *Stigmina millettiae.*

---

* Presently Head, Forest Protection Dlvision, Forest Research Institute, Dehra Dun.

The pathogen also attacked *Millettia pachycarpa* and produced mostly round spots but on some leaves it produced irregular spots as well. This was interesting but was not considered significant by Ellis (personal communication). He reports that the same pathogen is known to cause round spots on *M. auriculata* and irregular spots on *M. aciculiformis*.

This is the first record of the pathogen in India.

Acknowledgement

The authors express their thanks to the Principal & Head of Research for providing the necessary facilities.

SUMMARY

The pathogen *Stigmina millettiae* **Ellis on** *Derris robusta* **is reported as first record in this paper.**

डेरिस रोबेस्टा का एक नया पर्ण लांछन रोग

एम०डी० मेहरोत्रा व जो०एस० शर्मा

सारांश

इस अभिपत्र में डेरिस रोबस्टा के रोगकारक स्टिगमीना मिलेटिएइ एलिस का वर्णन प्रथमोल्लेख के रूप में किया गया है।

RESEARCH NOTES

(I)

PERFORMANCE OF *ACACIA ALBIDA* PLANTS RAISED FROM SHOOT CUTTINGS

Acacia albida has been found an exception among all the *Acacia* species for its charactor of propagation by shoot cuttings. Harsh & Muthana (1985) and Ahmed (1987) have successfully raised the plants of *A. albida* by shoot cuttings. Later one has reported the success in vegetative propagation without any root hormone. A doubt has been raised regarding the establishment and performance of *A. albida* plants raised from shoot cuttings. The performance of such plants has been examined by Ahmed (1987) upto 150 days from the day of planting in the field. The plants were planted in July 1986 in medium textured deep loam with pH 8.40. Plants have been regularly irrigated once in a month. The growth in plants in two years have been found excellent and much better as compared to that recorded in plants raised by seeds and planted in sandy areas.

It is evident from Table 1 that the maximum height and collar diameter in plants raised from cuttings is more than those observed in plants raised from seeds. The higher growth rate in the present study may be due to the better edaphic conditions.

In the earlier publication Ahmed (1987) has reported that the growth of *Acacia albida* planted in sandy area is better than any species of that zone. It is also evident from the present study that this species can also be raised successfully in deep loam even in marginally alkaline medium. So this species can be a good choice for the belt along rivers in Indo-Gangetic plains. The areas along rivers have deep sandy deposits with thick layer of sandy loam on the top. An area of this type in Karnal district (Shekhupura Reserve Forest) along Yamuna had earlier been planted with *Dalbergia sissoo Acacia nilotica*, *Eucalyptus* hybrid and *Poplar* but no one of these put on growth. *Acacia albida* which thrives well in sandy soil as well as in deep loam can be a much suitable species for such areas.

Table 1

Performance of A. albida plants raised from seeds and from shoot cuttings

Species	Period of Plantation (yrs)	Max. height (cm)	Max. C.D. (cm)
A. albida raised from seed	2	580	10.5
	4	750	20.6
A. albida raised from cuttings	2	750	11.5

References

Harsh, L.N. and K.D. Muthana (1985). Rooting media for vegetative propagation of *Acacia albida*, *J. Tropical For.*, **1** (III) : 275-276.

Ahmed, P. (1987). Vegetative propagation of *Acacia albida* : A promising species for farm forestry in arid areas. *Indian For.*, **113** (7) : 459-465.

Dy. Conservator of Forests,
Social Forestry Division,
Panipat (Haryana).

Parvez Ahmed

SALE **SALE** **SALE**

A few copies of the following **SPECIAL ISSUES** of the *Indian Forester* are available for sale :

November, 1969 — International Union for Conservation of Nature and Natural Resources.
January, 1975 — Indian Forester Centenary Issue.
February, 1979 — International Symposium on Tiger
September, 1984 — Biomass—II
November, 1985 — International Year of the Forests
December, 1985 — Eucalyptus IV
July, 1986 — Brandis Memorial/Environmental Conservation
October, 1986 — Wild Life
September, 1988 — Bamboo Special—I
October, 1988 — Bamboo Special—II

The cost of each issue is Rs. 30.00, Bamboo spl. I & II each Rs. 40.00. Forwarding charges will be extra. In case you intend to purchase any of these issues before the stock is exhausted, kindly send your order together with the relevant payment to :

The Business Manager,
INDIAN FORESTER,
P.O. New Forest,
Dehra Dun-248006 (India)

(II)

CHANGES IN SOIL PROPERTIES UNDER *ACACIA AURICULIFORMIS* PLANTATIONS IN TRIPURA

Acacia auriculiformis was introduced in an isolated manner in this state about 30 years back. An attempt to raise this species in small scale plantations was made by Forest Department in the year 1962. This, however, did not gain momentum in view of the fact that better species than *A. auriculiformis* could be raised in those days under the prevailing locality and biotic factors at that time. With denudation and desication of soil coupled with problems of fire and grazing, it was found that *Acacia auriculiformis* is one of the important species for afforestation particularly under poor soil conditions. The success of the plant in fallow and degraded lands is found to be very much promising. And because of high percentage of survival, this is quite in demand for afforestation under social forestry schemes.

The present study was carried out to see the changes in chemical properties of the soils under plantations of different ages in comparison to control.

Study area

The study area falls between latitude 23° 38′ – 23° 41′ North and longitude 91° 17′ –91° 21′ East in Charilam Reserve Forest under Sadar Forest Division, Agartala, Tripura West.

The study was conducted in 2, 3 and 4 year old *Acacia auriculiformis* plantations which were raised in 3 × 3 m spacing in open northerly slopes where only vegetation represented by *Eupatorium odoratum* as shrub storey and *Cynodon dactylon* and *Borreria hispida* forming the ground cover.

Materials and Methods

10 samples from 0-10 cm depth were collected from each plot randomly in the month of August, 1986. The collected soil samples were analysed in the laboratory for colour, pH, electric conductivity, water holding capacity, organic carbon, nitrogen and potassium (Jackson, 1967).

Results and Discussion

The colour of the soil changes from light yellowish brown to brown The plantations brought about changes in pH from acidic (5.9) to slightly alkaline (7.6) in nature. Similarly electric conductivity of the soil increases from 27.9 to 48.4 mmhos according to the age of the crop. The result also shows increase in water-holding capacity from 22.9 to 32.7% of the soil after plantation according to the age of the crop and is directly related to organic carbon content.

The data below shows that the soils under plantation showed increased organic carbon in comparison to control land. The organic carbon in no plantation site is only

Table 1

Physico-chemical properties of soil under Acacia auriculiformis plantation.

	Colour	pH	Electric conductivity (micro-mhos/cm.)	Water holding capacity (%)	Organic Carbon (%)	Nitrogen (%)	Potassium (mg/lit.)
Control	10 YR 6/4	5.9	27.2	22.9	0.81	0.364	5.45
2 Year old	10 YR 7/4	6.7	29.5	24.1	0.96	0.370	5.85
3 Year old	7.5 YR 5/2	6.7	43.4	27.6	2.27	0.462	6.60
4 Year old	7 5 YR 5/4	7.6	48.4	32.7	2.70	0.504	7.10

0.81% which has increased to 2.70% due to growing of *A. auriculiformis* for 4 years. Similarly N content also increases from 0.364 % in barren land to 0 504% in plots with 4 years old *A. auriculiformis*. The changes in K content is also significant due to raising of *A. auriculiformis*.

The results so obtained reveal that the soils under *Acacia auriculiformis* show a trend of improvement in physico-chemical properties in case of pH, electric conductivity, water holding capacity, organic carbon, nitrogen and potassium content.

The changes in physico-chemical properties in 3 and 4 year old plantations are remarkable. This may be attributed to the fast growing nature of the species where even the 3 year old plantation can provide a good soil coverage and accumulation of leaf litter.

Reference

Jackson, M.L. (1967). *Soil Chemical Analaysis*, Prentice Hall of India Pvt. Ltd., New Delhi.

* Addl. Chief Conservator of Forests Tripura,
Agartala (Tripura).
** Divisional Forest Officer,
Research Division, Agartala (Tripura).

R.N. Chakraborty*
and
D. Chakraborty**

(III)

LEAF BLIGHT DISEASE OF *EUCALYPTUS TERETICORNIS* CAUSED BY *ALTERNARIA PADWICKII*

During the month of March, 1978 leaves of *Eucalyptus tereticornis* Sm. coppice shoots showed symptoms of a hitherto unreported malady. The symptoms were first noticed on few 8 months old coppice shoots at Kurubanappara area in the Kottappara range of Malayattoor Forest Division and later on five months old coppice shoots elsewhere also showed such symptoms. The affected leaves showed reddish discoloured areas along the margins which coalesced at times at the distal portions causing complete blighting of the leaves. The discoloured areas had a prominent yellow halo and plants showed severe defoliation consequent on infection. The ground underneath the plants was covered with the infected leaves. Conidia of *Alternaria* were observed when scrapings from blighted leaf surface were examined under the microscope. Surface sterilized bits of infected leaf tissue when incubated inside moist chambers at 23°C for 12 hrs produced plenty of *Alternaria* conidia.

The fungus was isolated by tissue culturing infected leaf tissue on malt agar medium. The culture characters and spore morphology were studied. The week old actively growing malt agar culture of the fungus was used to inoculate healthy tender semi-mature and mature leaves of *E. tereticornis* leaves of two year old trees, by keeping 0.5 cm culture discs adpressed to the leaf surface, covering it with moist cotton and enclosing the inoculated leaves inside polythene bags with some moist cotton and some water inside it to maintain high relative humidity. Leaves of 5 month old *E tereticornis* seedlings in the nursery bed were also inoculated similarly.

The inoculated leaves in both cases were seen to have typical reddish leaf lesions as seen in the field when the inoculated leaves were observed after 4 days. Shedding of infected leaves was also noticed in some cases.

Fungal colonies were effuse thin. Mycelium partly superficial, partly immersed. Sclerotia spherical or sub-spherical, black with reticulate walls, mostly 50-200μ diameter. Conidiophores upto 180×3-4μ, often swollen to 5-6μ at the apex, smooth except at the apex which is often minutely echinulate. Conidia straight as curved, fusiform to obclavate and rostrate the beak at least half and often more than half the length of the conidium, at first hyaline, later straw coloured to golden brown, smooth or minutely echinulate, often echinulate only near the scar, 95-170 (130)μ long, 11-20 (15.7)μ thick in the broadest part, 1.5-5 (2.7)μ thick in the centre of the beak, with 3-5 (most commonly 4) transverse septa in the body of the conidium and often one or more septa in the beak, sometimes constricted at the septa. The fungus grows well in culture on malt agar forming light greyish colonies often deep grey to black on the reverse, sporulating sparsely in culture. Small black sclerotia with very distinctly reticulate walls are often formed in old cultures.

The fungus has been identified as *Alternaria padwickii* (Ganguly) M.B. Ellis by the Commonwealth Mycological Institute (IMI No. 228645).

This is a first report of the pathogen on *E. tereticornis.*

Eucalyptus Fungus Investigation Unit,
Hindustan Paper Corporation Ltd.,
Alwaye (Kerala).

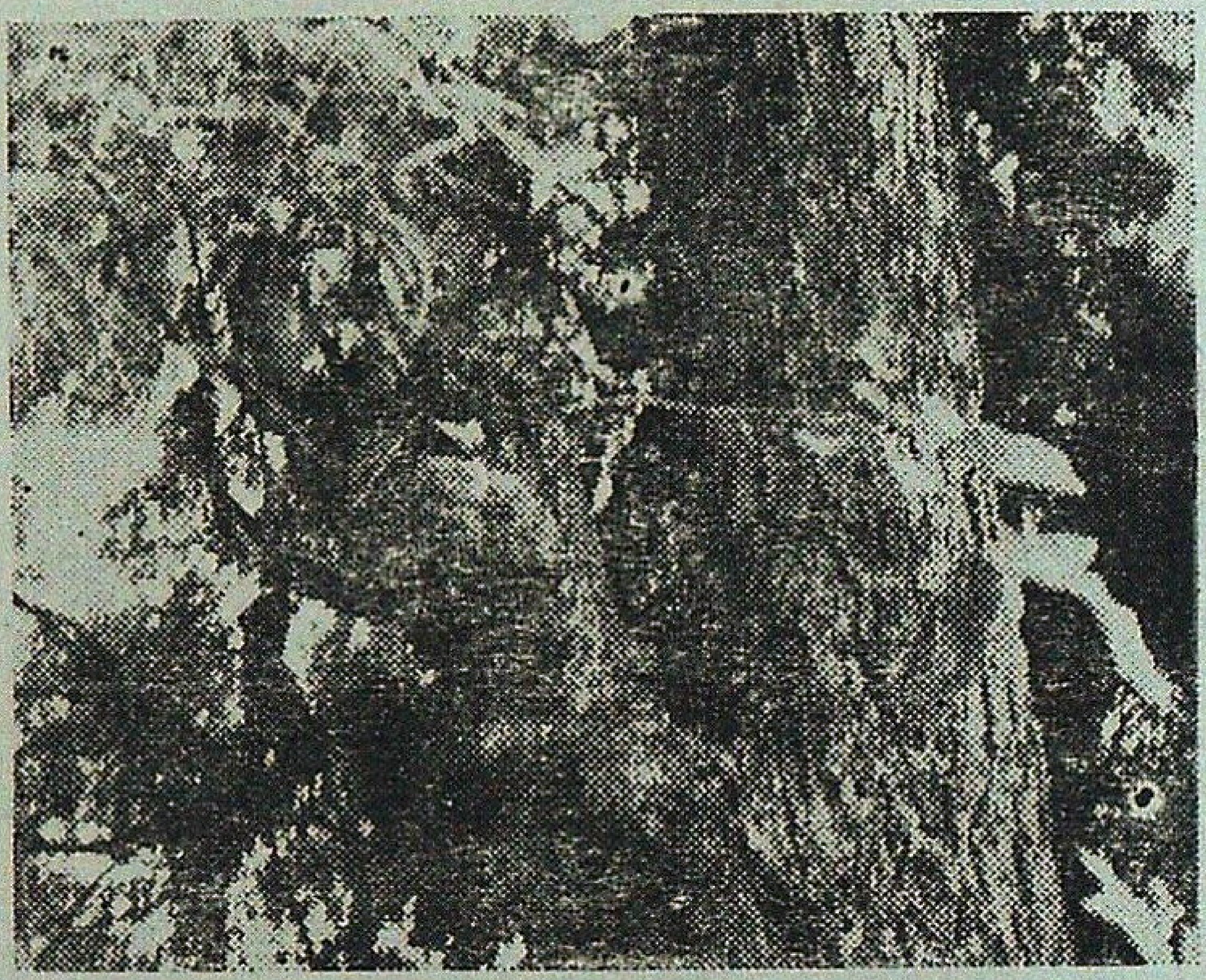
L. Thankamma
and
J. Madhavan Nair

(IV)

AZADIRACHTA INDICA A. JUSS., THE HOST OF *FICUS RELIGIOSA* LINN.

Ficus religiosa Linn., commonly known as peepal tree; either planted or self sown; is known to occur, along the road sides, in waste places, and near religious places. When it grows on walls and terraces of buildings, it causes serious damages. Further it is said to be epiphytic and found growing on other trees, Cooke (1958, rep.) and Oza (1975).

Recenly, in the month of August 1987, author noticed *Ficus religiosa* Linn., growing on the main branch of *Azadirachta indica* A. Juss., along the road side, Bharuch (Broach), Gujarat. The present finding confirms the earlier records published by Cooke (1958, rep.) and Oza (1975), but the host *Azadirachta indica* A. Juss., popularly known as Neem tree, is listed for the first time for *Ficus religiosa* Linn, from Bharuch, Gujarat.



Ficus religiosa Linn; Sheltered on the main branch of *Azadirachta indica* A. Juss.

The epiphytic nature of religiously venerated *Ficus religiosa* Linn., will cause considerable damage to the well established, economically important member, of land ecosystem, *Azadirachta indica* A. Juss.

References

Cooke, (1958). *Flora of the presidency of Bombay* III 149, rep.

Oza, G.M. (1975). Epiphytic peepal nourishing branch parasite *Dendrophthoe* and small flowered *Ixora. Indian For.*, **101** (7) : 428.

Biology Department,
Shree Jayendrapuri Arts and Science College,
Bharuch (Gujarat).

K.J. Vyas

LETTER TO THE EDITOR

To

The Hony. Editor,
Indian Forester,
P.O. New Forest, Dehra Dun

Sub : Tiger without stripes

Sir,

In Similipal Tiger Reserve we have maintained a few artificial ground-salt-licks. These places attract the herbivores in patterns which change during different seasons. Because of the preponderance of herbivores, carnivores like tiger (*Panthera tigris*) and wild dog (*Cuon alpinus*) are also sighted near the salt licks. All sightings are recorded in animal sighting registers showing the date, time, species, number and activity etc. maintained at each salt licks.

On the 27th July, 1988 at 0640 hrs the guard at Brundaban (North Similipal) saw "a tiger without stripes", walking away from the salt lick. Later the guard had inspected the spot and had even seen an imperfect pug mark of a tiger. We have never seen the tiger again but without doubt we believe the observation of the guard.

We have consulted people who are familiar with Similipal and its natural history. Those who believed the observations suggested that 'it could be an old tiger'. We also reason that it could be a physiological phenomenon or disorder with symptom resembling greying of black hairs in human being. The possibility of sighting a 'white tiger' cannot be ruled out too.

In the meantime we have gathered three other sightings of tigers without stripes. Shri Shailesh Ho, a very experienced tracker belonging to the Kolha community had seen such a tiger in 1977 at about 0800-0900 hrs in Mahubhandar forest near Kalika Prasad (North-west Similipal). Shailesh had again seen such a tiger in 1979 during the morning hours near Khadkei (Panasia) beat house in North-east Similipal. The other observation is by a very senior officer of the I.P.S. cadre. He had seen the animal in 1961 near Balimela (Chitrakonda) close to Orissa-Andhra Pradesh border.

We would have ignored the observations of 27.7.88 but for the additional information coming in from other persons, without provocation. We believe that some of the *Indian Forester* readers may have also seen such tigers without stripes but have never talked about it seriously because the friends and peers will find it hard to accept. We request such readers to write about their observations and offer their explanation to such curious phenomenon of nature.

Yours faithfully,

Sd./- S.R. Sagar
Field Director
Similipal Tiger Reserve, Baripada (Orissa)
and
Sd./- L.A.K. Singh
Research Officer
Similipal Tiger Reserve
Khairi-Jashipur (Orissa)

Date : 27 Dec., 1988

GAZETTE NOTIFICATIONS

ANDHRA PRADESH GAZETTE

The following transfers and postings are ordered :

1. Shri D.S. Gangakhedkar, I.F.S , Deputy Conservator of Forests, Wild Life Investigation, Hyderabed is transferred and posted as State Silviculturist, Hyderabad.

2. Shri K. Mohan Reddy, I.F.S., on return from leave is posted as Deputy Conservator of Forests (M.C.) in the Office of the Prl. Chief Conservator of Forests, Hyderabed, vice Shri M. Narayana Rao, Deputy Conservator of Forests (State Cadre) transferred.

3. On transfer, Shri M. Narayana Rao, I F.S , Deputy Conservator of Forests (S.C.) is posted as Deputy Conservator of Forests, Wild Life Investigation, Hyderabad vice Shri D.S. Gangakhedkar, I.F.S., already transferred.

KARNATAKA GAZETTE

On repatriation from the Government of India, Shri. P.J. Dilip Kumar, IFS is appointed with immediate effect and until further orders as Deputy Conservator of Forests, Forest Utilisation, Bangalore vice Shri. S. Venugopal, IFS transferred.

Shri S. Venugopal, IFS, Deputy Conservator of Forests, Forest Utilisation, Bangalore is appointed with immediate effect and until further orders as Deputy Conservator of Forests, Social Forestry Division, Gulbarga vice Shri K.P. Nagaraja, IFS proceeded on leave.

FOR SALE

Back Issues of *Indian Forester* (available)

Vol. 57—1931. April, June, July, Aug. Nov., Dec. and Index
Vol. 58—1932. Index only
Vol. 59—1933. April, June, Nov., Dec. and Index
Vol. 60—1934. Jan , Feb., March, and Index
Vol. 61—1935. Jan., Feb., March, April, May, June.
Vol. 64—1938. Index only.
Vol. 65—1939. April, June.
Vol: 67—1941. May only.
Vol. 71—1945. Index only.
Vol. 74—1948. August, Sept., Oct., Nov. and Dec.
Vol. 75—1949. Jan., March, June, July, August, Sept., Dec. and Index.
Vol. 76—1950 Jan., May, June, Nov. and Dec.
Vol. 78—1952. Index only.
Vol. 81—1955. Index only.
Vol. 82—1956. December (Special Issue) and Index.
Vol. 83—1957. Index only.
Vol. 94—1968. April, May, June, July, August Sept., Oct., Nov., Dec. and Index.
Vol. 95—1969. Jan., Feb., March, Nov. (Spl. Issue), Dec. and Index.
Vol. 100—1974. Feb. only.
Vol. 101—1975. January (Special Issue).
Vol. 105—1979. Dec. only.
Vol. 106—1980. Oct. and Dec.
Vol. 107—1981. June, July, August, Sept., Nov. and Index.
Vol. 108—1982. April, June to December and Index.
Vol. 109—1983. Jan., Feb., March, April, May, June, July, Aug., Nov.
Vol. 110—1984. Sept. (Spl Issue), Oct., Nov., Dec. and Index.
Vol. 111—1985. Sept., Oct., Nov. (Special Issue), Dec. (Special Isssue) and Index.
Vol. 112—1986. Jan, May, June, July (Spl. Issue), Aug., Sept., Oct. (Spl. Issue), Nov., Dec. and Index.
Vol. 113—1987. Jan., March, May, June, July, Aug., Sept., Oct., Nov., Dec. and Index.
Vol. 114—1988. January to December and Index.

1. Price :— Inland : Rs. 25 00 each, Special Issue Rs. 30 00 each and Index Rs. 5.00 each.
   Foreign : $ 12.00 each, Special Issue $ 12 00 each and Index $ 2.00 each.
   Bamboo Spl. I & II each Rs. 40.00 or $ 12.00.
2. Packing and forwarding charges will be extra.
3. The above offer is subject to prior sale of any issue in the meanwhile.

For further details please contact :—

Business Manager,
INDIAN FORESTER
P.O. New Forest-248006, Dehra Dun (UP), India

FRI Publications

FOREST RESEARCH INSTITUTE & COLLEGES, DEHRA DUN

1. Wasteland Development for Fuel Wood and Fodder Production (Symbol No. PFRI-218)
Price Rs. 35.60 or $ 12.85 or £ 4.15

Available from :

The Controller of Publications,
Deptt. of Publication,
Civil Lines, Delhi–110 054

PROVIMI

SALTLICKS

FOR CATTLE, GOAT, SHEEP, HORSES,
DEERS, TIGERS, PUMAS, ZEBRAS &
Other Forest Animals.

CONTAINING : Iodine
Iron
Copper
Cobalt
Manganese
Magnesium
Zinc
Sodium

India's Top Selling Lick !

Provimi Saltlicks are of Vital Importance for the Health of your Livestocks

Manufactured By : **Provimi Products Private Ltd.**
Regd. Office : BANGALORE,
Factory & Administration,
3-F, Mill Road,
GOBICHETTIPALAM-638 476
Tamil Nadu.
Phone : 2593, 2493, 2707 & 2720.

for quality

PLEASE STEP TO—

Nocte Timber Company Limited

A Subsidiary of

Arunachal Pradesh Forest Corporation Ltd.

(A Govt. of Arunachal Pradesh Undertaking)
P.O. DEOMALI, TIRAP DIST. VIA-NAHARKATIA,
PIN–786629 (Arunachal Pradesh)
Phones Dl. 27, 29, 30.

Manufacturer of :—

Hot Pressed resin bonded, Commercial Plywood,

Decorative Plywoods, Shuttering Plywoods,

Nocte Special, Flush Doors

&

Block Boards.

SIMILIPAHAR

—a feast of floral and fauna beauty.

Similipahar a sal forest with scanty tribal populace in the district of Mayurbhanj, Orissa, has been implemented by Govt. of Orissa under recommendation from National Commission on Agriculture, for development of Forest and Forest Produce since 1979 under the banner Similipahar Forest Development Corporation Ltd. SFDC alongwith other activities have pledged them selves for a socio-economic growth of its inhabitants.

SFDC DEALS IN:

Timber, Firewood, Sal Seed, Railway Sleepers, Colliery Materials, Honey, Resin, Arrowroot, Gums, Tamarind and other forest products.

SFDC TAKES UP

Construction of Roads, Bridges, Culverts, Storage Godowns inside Similipahar Forest areas Plantation of Teak, Sal, Gamhar and other species and development of forest Generates employment among adivasis in forest workings about twenty lakhs a year.

SFDC BRANCHES AT

Baripada, Badampahar, Karanjia Udala Keonjhar, Jajapur Road Bhawanipatan, alongwith beautiful rest-houses in the midst of forest growths with connecting roads for tourists

SFDC SERVES PEOPLE:

Firewood supply in 245 retail sale centres.

SFDC PROCESSING PROJECTS:

Import of Malayasian timber to save our forest. Plantation of Simarouba Glauca to meet oil seed deficit Plantation of rubber to save foreign exchange

ORISSA

THE SIMILIPAHAR FOREST
DEVELOPMENT CORPORATION LTD.,
(A GOVT. OF ORISSA UNDERTAKING)

McCULLOCH
McCULLOCH
McCULLOCH
McCULLOCH
McCULLOCH

Available in India for the very First Time with Chain Brake Attachment

McCulloch. The Professional Dealer Choice

1. Bar length available 24," 28" & 32".
2. All essential spares and after Sales Service readily available.

Please Contact :
"SOLE DISTRIBUTOR
in India".

M/s. Indiana International

2001, Ugger Sen Street, Bazar Sita Ram, Delhi-110 006
Phone : Office : 734868 Resi. : 224-2737 Gram : "POWERCHAIN"
Res. Address : F-42, PREET VIHAR, DELHI-110092

CORBETT NATIONAL PARK, RAMNAGAR (NAINITAL) U.P.

Beckons you to its land of Roar, Trumpet and Song.

Have a date with nature in its superb magnificence and enjoy the thrill of observing wild animasl roaming freely in the vast wilderness. A paradise for bird watchers and anglers.

Elephants, chital, sambar, hog deer, barking deer, wild boar, magar gharial etc. and incredibly large varities of numerous beautiful birds. There is also very good chance of seeing tiger, panther or a bear in their natural habitat.

- Elephant rides arranged at reasonably low rates.
- Still photography permitted free; cine photography on nominal payment.
- High watch towers and tree top machans available for wildlife viewing.
- Picturesque scenery of the park provides an ideal holiday resort.
- Wildlife films screened daily free of charge.
- Well furnished Rest Houses and lodges available at various tourist centres inside the Park.
- Regular bus service available from Ramnagar to main tourist centre (Dhikala).

Nearest Rail Head—Ramnagar (N.E. Rly)
Nearest Bus stop—Ramnagar
} 50 kms from Dhikala

For other information contact or write to :

The Field Director, Project Tiger
Corbett National Park,
Ramnagar (Nainital), U.P.—244715
Phone : 32, 189 Office
76—Residence

OR

The Chief Wildlife Warden
17-Rana Pratap Marg,
Lucknow (U.P.)
Phone : 46140—Office
46817 Residence

Solar Powered Energy (Electric) Fence

Is protection a problem in your afforestation scheme? It is the damage to crops or wild-life protection that worries you?

Afforestation work can be a total failure due to bad protection, may be from wild animals or from cattle, and all your efforts wasted.

Erect Solar Powered Energy (*Electric*) *Fence.* It gives total protection even from elephants and destructive wild boars.

Energy (Electric) fence is effective, easy to install, economic and safe. Above all, it is environmentally clean, and ecologically compatible in forest areas. Totally dependent on Solar power, it is suitable even for remote areas, requiring minimum maintenance.

Please contact us for further details.

SURAKSHA
ENERGISERS

530-A 3RD CROSS, 3RD MAIN, R.T. NAGAR
BANGALORE-560 032, Karnataka (India) Phone : (0812)-333666/369777

Punjab State Forest Development Corporation Ltd.

Regd Office and Showroom : SCO 391, Sector 37-D, CHANDIGARH.

In view of large scale plantations of eucalyptus trees raised on private lands in the States, the Corporation has made efforts to find out multiple uses of eucalyptus wood. Apart from uses of eucalyptus for battens, crates, firewood, pulpwood etc., the Corporation has developed uses of eucalyptus for packing cases, building construction, truck body building, furniture making, tool handles, wooden poles, plywood, activated charcoal etc. The Corporation has received orders from the Punjab Housing Development Board for supply of eucalyptus timber to be used in the fabrication of door and window frames. The Corporation has taken in hand some work in regard to supply of battens to the Panchayati Raj Punjab, for use in their buildings.

The Corporation has recently embarked upon a prestigious programme for fabrication of lamps, items of household and office furniture as well as misc. articles of wood of daily use. The lamps are available in exquisite designs, shapes, sizes and are suitable for residences, offices, hotels, bars, lounges etc. The furniture made from eucalyptus wood is of good quality, durable, attractive, reasonably priced and of good finish.

For your requirements and further details, please contact the Managing Director.

Y.P. CHOWDHRY
Managing Director

Tel. 40586

With best compliments

from

WOOD PRESERVERS PVT. LTD.,

F-27, MIDC INDUSTRIAL ESTATE,
NAGPUR-440 016 (Maharashtra).

GRAM : WOODTREAT

Phone : Fact. 7451, 7210
Resi. 23131

Manufacturers for :

"Railway Sleepers, Pre-cut structures, Marine Constructions materials, Fabricated and engineered wood products, Wood Preservative Copper Chrome Arsenic Composition, Kiln drying Pressure Preservation treatment, Ammunition Boxes, Wooden Pallets, Packing cases and Crates."

"Enquiries particularly solicited for unusual and difficult items."

MOSS MIRACLE

Introducing First Time in India

"The Miracle for Forest Nurseries"

IDEAL SEED STARTER : Soak the seed for 10 Minutes in full Strength Solution of MOSS MIRACLE (1 tablespoon per gallon) and wet seed beds with regular full strength of water, plant seed as usual and sprinkle the solution on the seed beds. After sprouting, feed seedling again with a weak solution.

TRANSPLANTING : MOSS MIRACLE helps prevent transplanting SHOCK. When transplanting dip the roots in strong solution, and after transplanting, apply the left solution as a liquid fertilier.

ALL PURPOSE LIQUID FERTILIZER : MOSS MIRACLE contains vital plant Nutrients specially processed for quick absorption through leaves as well as roots. This fast double-acting method of plant nutrition has been proved by scientists of many major American Universities. **30 Seconds** after applying MOSS MIRACLE to roots of heavy, five foot plants, University scientists have discovered quantities of nutrients in plant tissue from roots through stems to top most leaves. It is this amazing assimilation that helps to produce fast & strong growth.

DIRECTIONS FOR USAGE : Mix one teaspoon of MOSS MIRACLE to one gallon of water and just spray the MOSS MIRACLE Solution over the plant until most of the leaves are wet. Then soak the soil around roots just as you would when watering plants. Leaf feeding is recommended for nurseries and outdoor plantations only. Many experts prefer to feed using a very weak solution for regular use. Mix approximately 1/4 teaspoon of MOSS MIRACLE to one gallon of water.

SAFE : Moss Miracle will not "burn" roots or foliage when mixed with water according to directions. Use it any time, even in hot, dry summer.

"GUARANTEED ANALYSIS OF MOSS MIRACLE"

Total Nitrogen (N)	15%
6.8% Ammonical Nitrogen	
8.2% Urea Nitrogen	
Available Phosphorie Acid (P_2O_5)	30%
Soluable Potash (K_2O)	15%
Boron (B)	0.02%
Copper (Cu)	0.07
Iron (Fe) 0.15% Chelated Iron	0.15%
Manganese (Mn)	0.15%
Molybdenum (Mo)	0.005%
Zinc (Zn)	0.06

MOSS

8, Panchvati Society, Ambawadi, Ahmedabad-380006. India Phone : 444409

ROOT HORMONES & GIBBERELLIC ACID AVAILABLE

GROW POPLARS FOR PROSPERITY

AND YOU WILL HELP AMELIORATE THE ENVIRONMENT TOO

The **WIMCO-NABARD** Farm Forestry Project in U.P., Punjab and Haryana offers you the benefits of combining forestry with farming to increase your returns.

WIMCO provides:

- High quality plants of selected Poplar clones.
- Extension services and technical guidance till harvest.
- Assistance in securing bank loans and insurance cover for Poplar trees.
- Buy back guarantee at assured minimum price at 8 years rotation.

Over 5000 farmers have planted more than 48 lakh trees from 1984 to 1988.

Districts covered

U.P. : Moradabad, Bareilly, Meerut, Badaun, Shahjahanpur, Saharanpur, Ghaziabad, Pilibhit, Lakhimpur Kheri, Bijnor, Bulandshahr, Rampur, Nainital, Aligarh, Etah, Bahraich, Hardoi, Muzaffarnagar.

Punjab : All districts.

Haryana : Karnal, Ambala, Kurukshetra, Sonepat, Hissar, Jind, Sirsa, Rohtak & Faridabad.

Just write to us, or visit our office nearest to you, for more information.

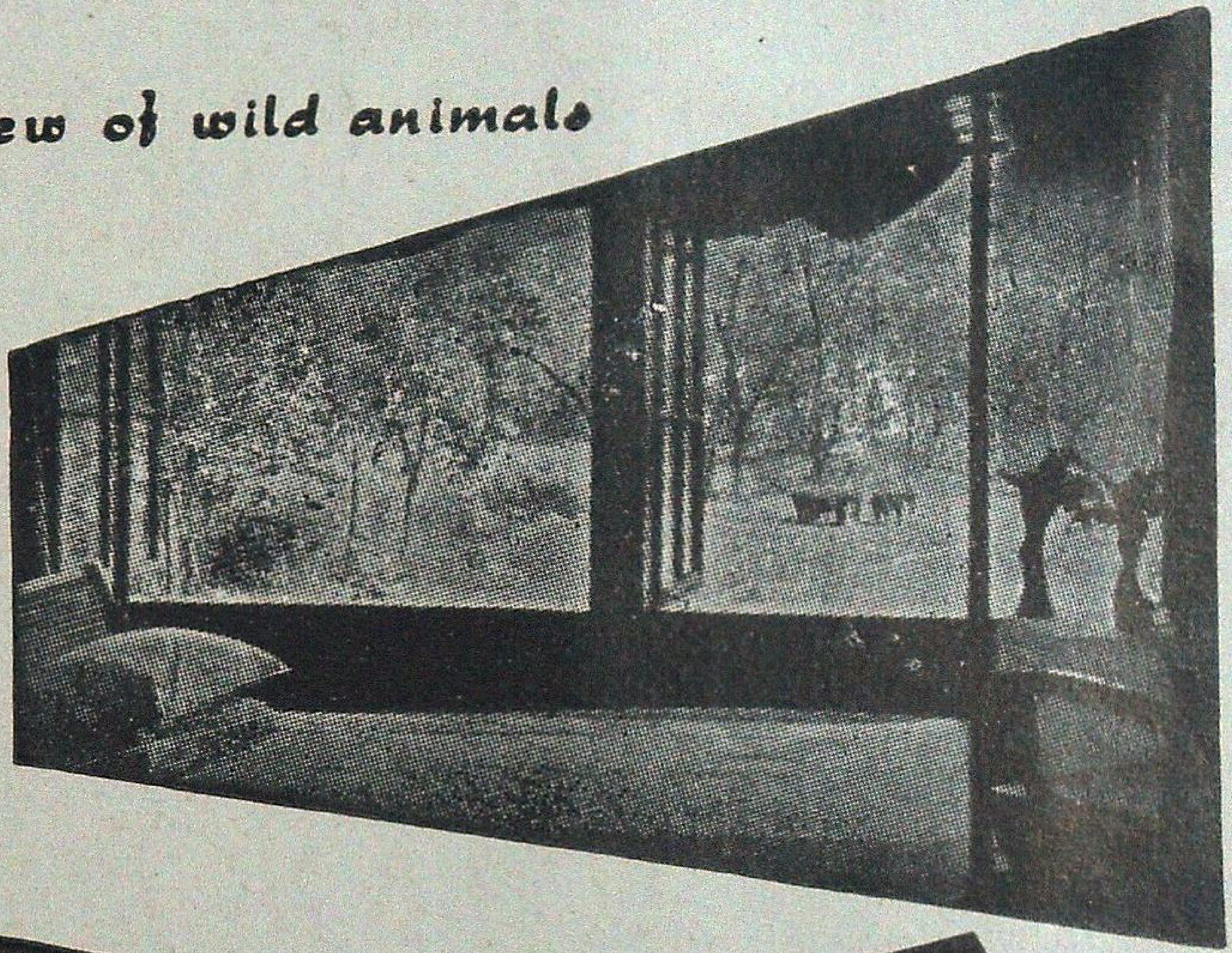
WIMCO

WIMCO LIMITED

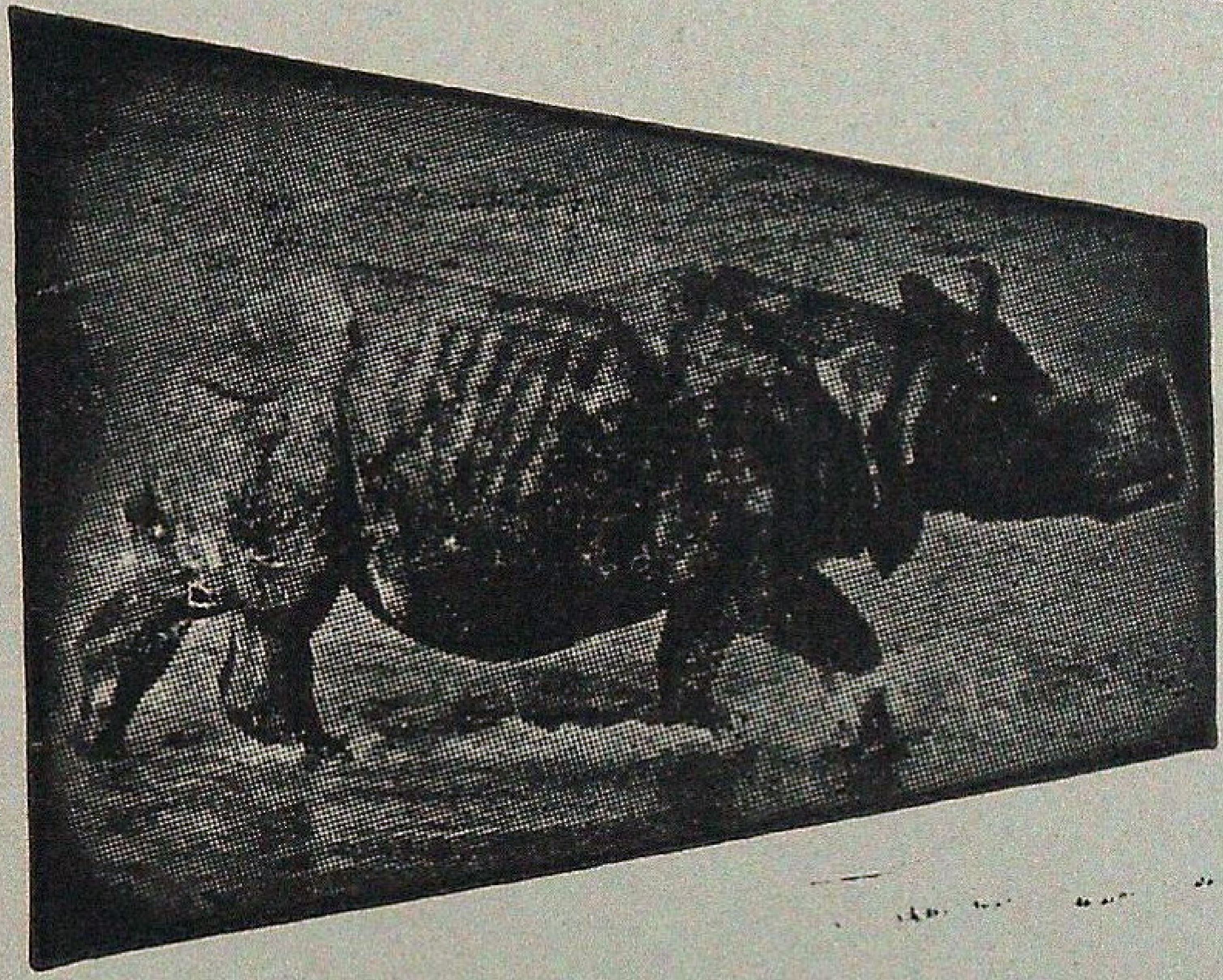
No. 5, Block E, Local Shopping Centre, Masjid Moth,
New Delhi-110 048

Moradabad : 9, Awas Vikas, Civil Lines. Ph : 27992.
Bareilly : B 9/35, Rampur Garden. Ph: 72081.
Meerut : F-194, Shastri Nagar. Ph. 73202
Chandigarh : 224, Sector 18-A. Ph. 20558.
Karnal : 843, Sector 13,
Urban Dev. Estate.

Have a bedroom view of wild animals



VISIT



JALDAPARA WILD LIFE Sanctuary

- Home of One-horned Rhinoceros.
- Gaur, Elephants, Tigers.
- Varieties of Deer and other Animals.
- Furnished Tourist Lodges with full Catering arrangement.
- Approachable by Road, Train and Air.
- Jeep available.

Please contact :

DIVISIONAL FOREST OFFICER
WILD LIFE DIVISION–II
JALPAIGURI
(WEST BENGAL)

OR

FOREST UTILISATION OFFICER
8, Lyons Range, CALCUTTA
[Phone : 22-2774]
WEST BENGAL

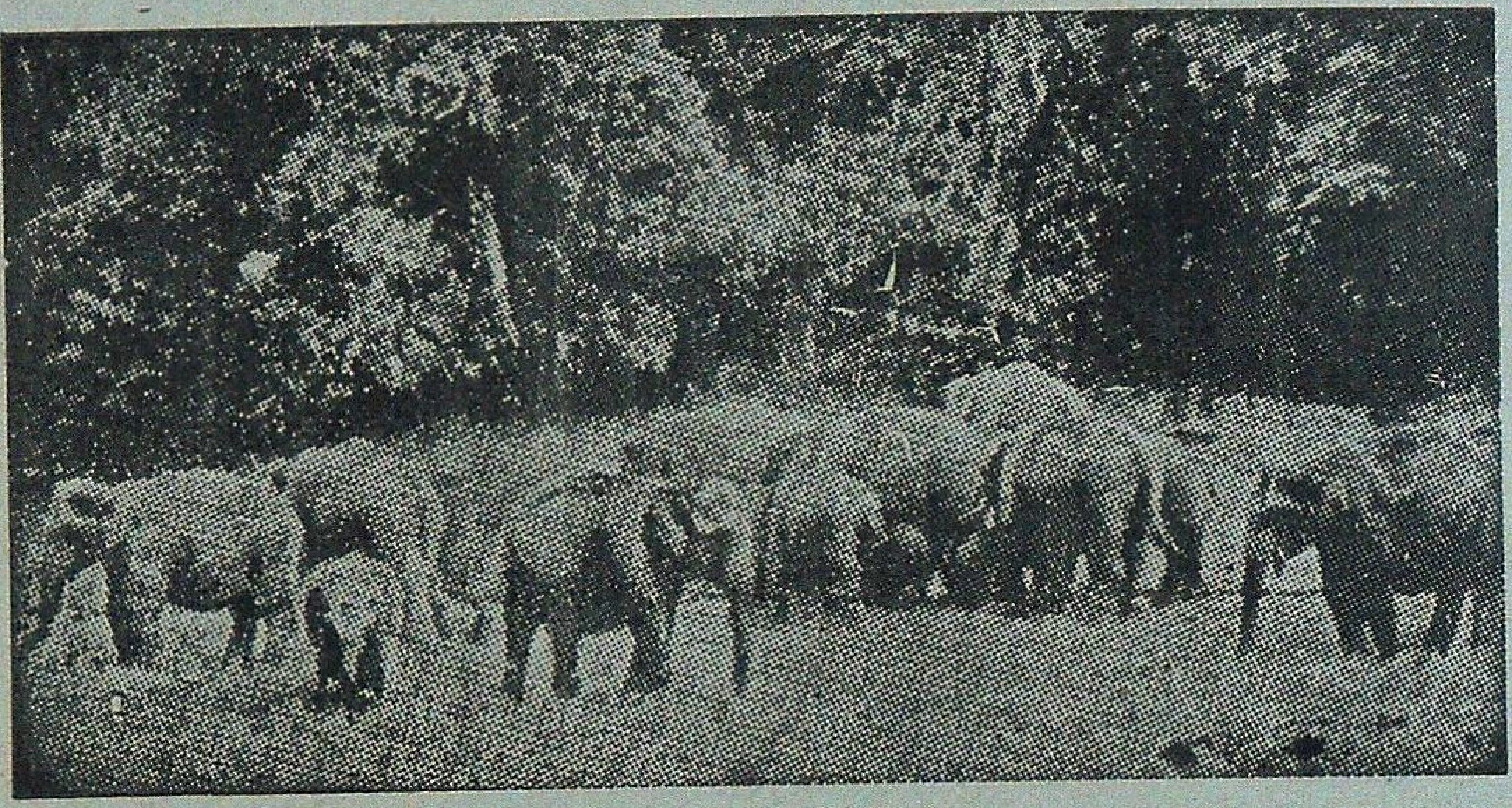
VISIT **PERIYAR TIGER RESERVE**

THEKKADY (KERALA STATE)
(OPEN ALL YEAR)

OBSERVE

Elephants, Gaur, Sambhar Leopard, Wild Dogs, Black Langur, The Giant Malabar Squirrel, Birds and other indigenous Fauna.

—



Hotels :
Western Style—Aranya Nivas
Indian Style—Periyar House.
(Accommodation in Hotels reserved by Managers)

†Frunished Forest Rest Houses at Thannikudy, Mullakudy and Manakavala.
†Motor Boats available for most enjoyable cruise in the lake.
†Elephant rides.
†Approachable by Air or Rail up to Cochin or Madurai.
Distance to Thekkady by roads is 190 km from Cochin, 145 km from Madurai and 110 km from Kottayam.

For further particulars contact :—WILD LIFE PRESERVATION OFFICER
Thekkady P.O., (Kerala) Telephone : KUMILY 27

FOR ROPING AND PLANTING TREES

POLYTHENE BAGS

GUSSETTED-PERFORATED OR PLAIN

Contact for Immediate Supply

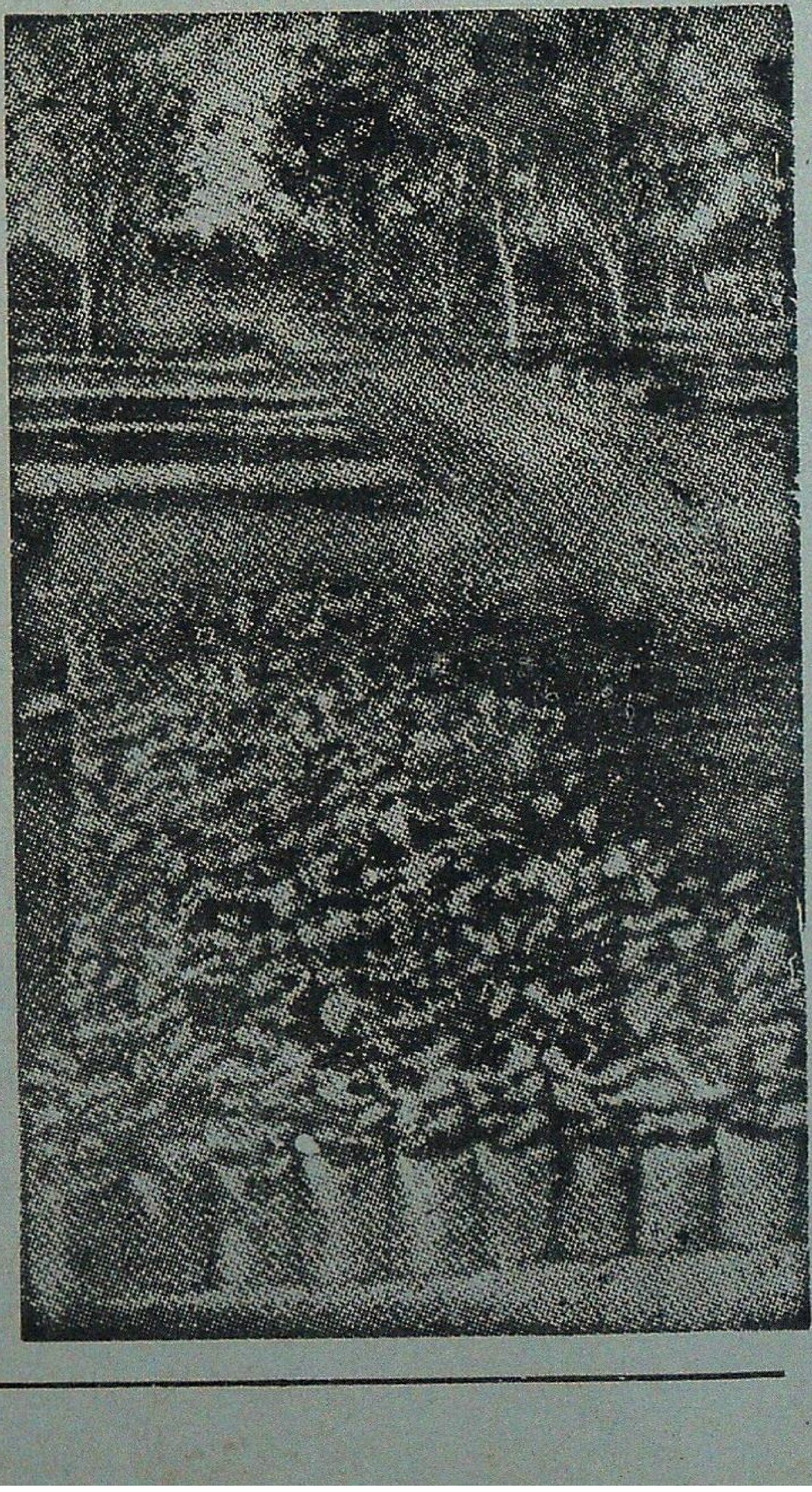
KANPUR PLASTIC COMPANY

111/423, Ashok Nagar, KANPUR-208 012

Phones Office : 243721 & 244992
Resi. : 245954 Gram—KANPLASTIC
Fac. : 244993 Estd.—1956

———

ALL SIZES OF POLYTHENE BAGS IN REQUIRED GAUGE & SPECIFICATIONS AVAILABLE



Himachal Pradesh State Forest Corporation Ltd.

(A Govt. of Himachal Pradesh Undertaking)
SHIMLA

HPFSC marches ahead towards a better tomorrow under the dynamic guidance and leadership of Hon'ble Chief Minister Shri Vir Bhadra Singh.

Himachal Pradesh State Forest Corporation has taken long strides under the benevolent guidance of our Chairman Prof. Chander Kumar, Hon'ble Minister of State for Forests.

* With complete nationalisation of forest working viz; timber operations, resin tapping etc. both in Govt. and private forests, there is complete elimination of contractor' agency. Modernisation of timber operations has reduced conversion wastage considerably and the incidence of organized illicit felling in forests is completely under control.

* To ensure gradual reduction in use of valuable coniferous timber for packing cases, effective steps have been taken for distribution of Card Board Cartons and purchase of Wooden Packing Cases from adjoining States of Punjab and Haryana.

* Stocks of timber extracted by Corporation are being supplied towards developmental works by catering to the requirements of Indian Railways, Director General of Supplies and Disposals, Defence Organisation and other Govt. Indenters. Sale of timber stocks is being organized through well established sale depots conveniently located.

* The annual turn-over has registered a significant increase from its inception from 1974-75 being Rs. 2.43 crores to Rs. 44.83 crores in 1986-87.

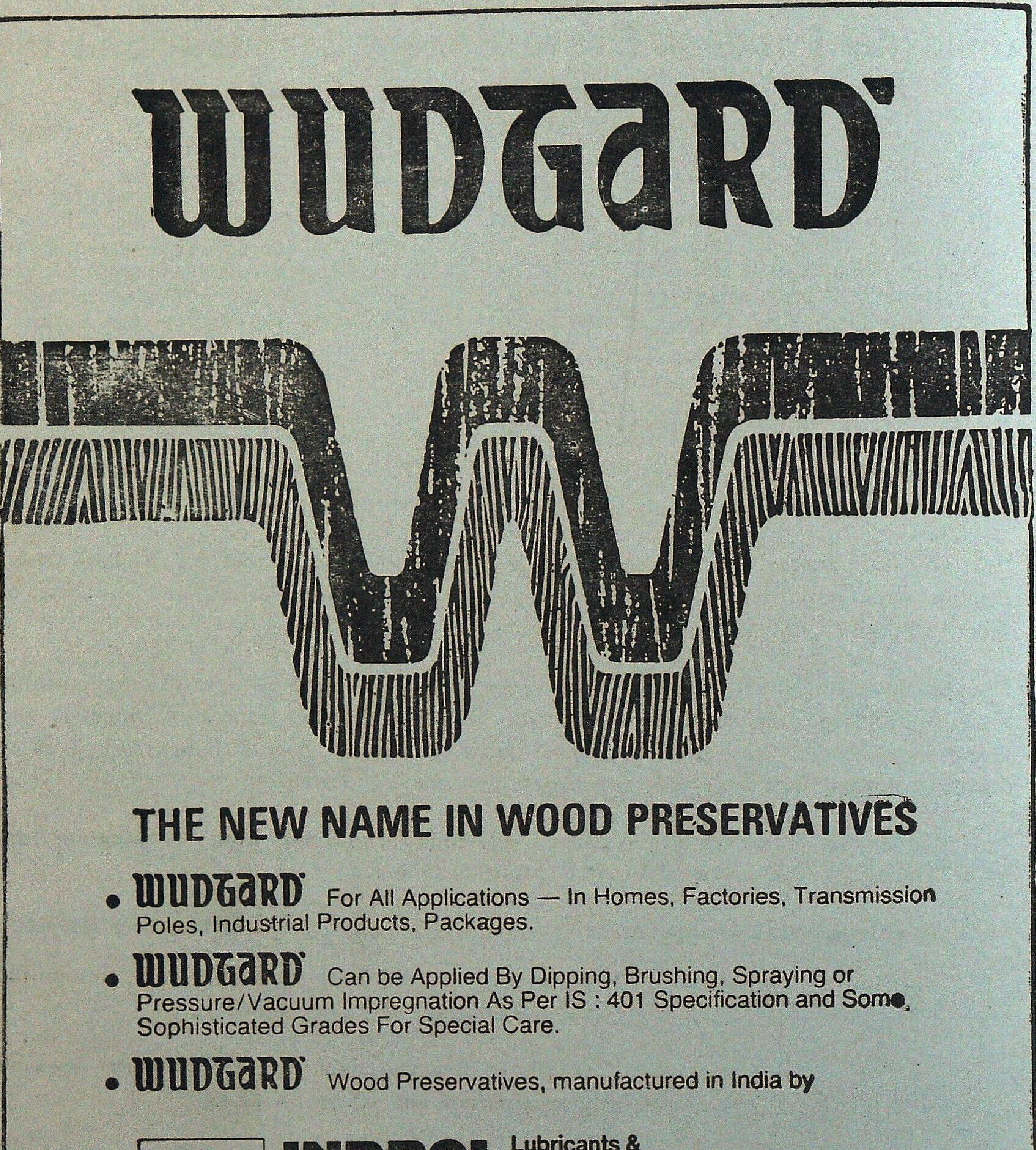
In order to maximize operational efficiency, following steps have now been initiated :

a) Replacement of old fleet of trucks for minimising transportatton time of timber to depots;

b) Analysis of financial data through computer net-work to ensure prompt and efficient working.

c) Providing incentives to officers and staff through prompt action on service matters like confirmations, job rotation vis-to-vis career planning including specialized training.

(V.P. Mohan)
Managing Director.



WUDGARD

THE NEW NAME IN WOOD PRESERVATIVES

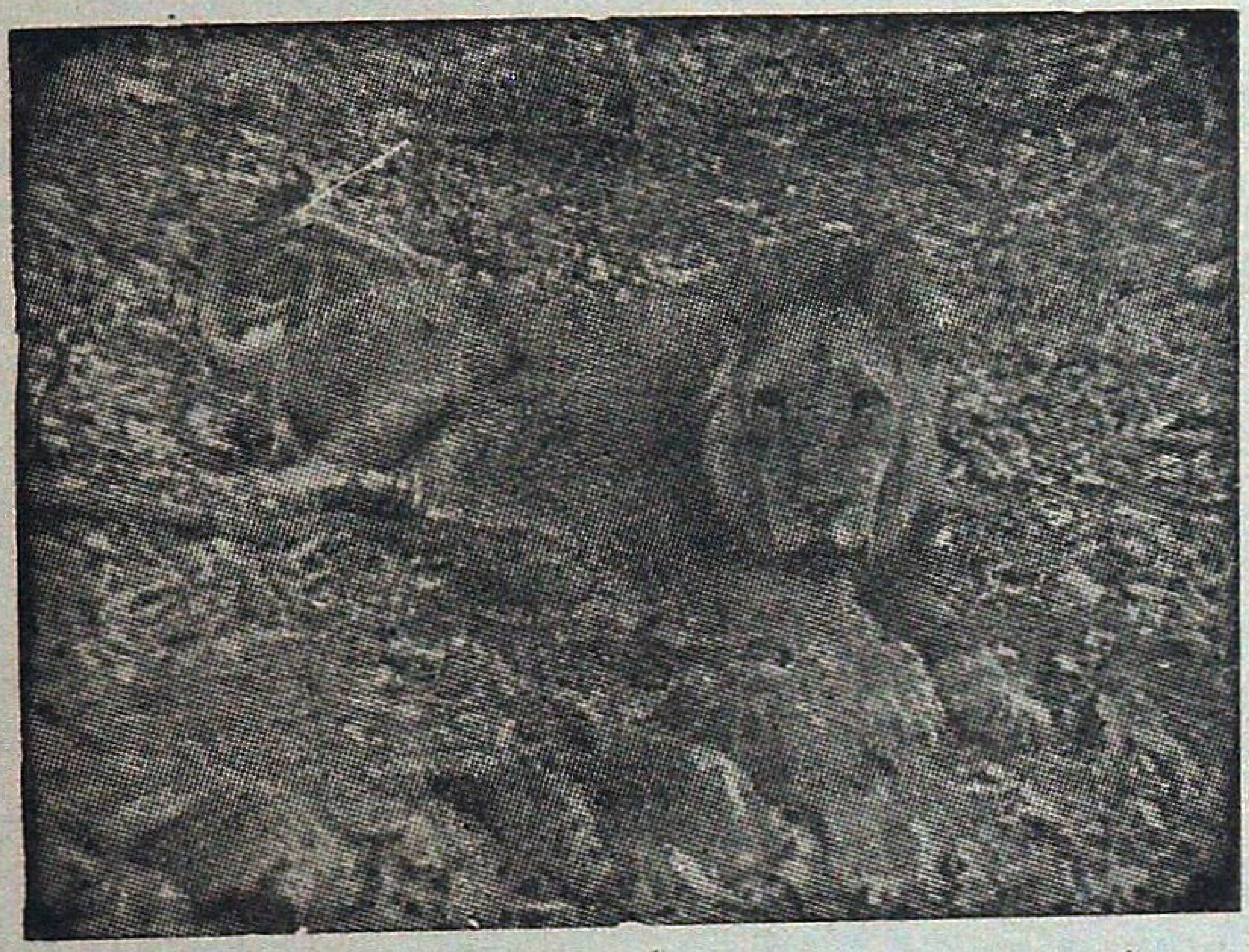
- **WUDGARD** For All Applications — In Homes, Factories, Transmission Poles, Industrial Products, Packages.
- **WUDGARD** Can be Applied By Dipping, Brushing, Spraying or Pressure/Vacuum Impregnation As Per IS : 401 Specification and Some Sophisticated Grades For Special Care.
- **WUDGARD** Wood Preservatives, manufactured in India by

INDROL Lubricants & Specialities Ltd.

Head Office: 91, Walkeshwar Road, Bombay-400 006
Branches at Bombay, Calcutta, Delhi and Madras
Depots and Consignment Stockists — All Over India

Yorvicson

The Moments of Life Time Experience await you



IN SASAN–GIR

you have a date with the

King & Queen

of Animal World

The most Majestic Royal
Animal species—

The Rare
Asiatic Lion

For more details contact :

Deputy Conservator of Forest,
Wild Life Division,
P.O. Sasan-gir - 362 135
Distt. Junagadh, Gujrat,

VISIT : **Palamau National Park**

Famous for the abundance and variety of wildlife—Tiger, Panther, Elephant, Gaur, Samber, Spotted deer, Barking deer and numerous species of beautiful birds,
*Picturesque Scenery.
*A place of historical importance—the old and the new Palamau Fort of
*Chero Kings.
*Ideal holiday resort.
Well furnished tourist Lodges and
*Forest Rest Houses with catering arrangement.
*Beautiful Watch Towers, tree-top and Hide-outs-all connected by roads.
*Remains open throughout the year.
Snaps and movie permitted free of
*charge.
Approachable by road and rail–26 kms from Daltonganj 12 kms from Chhipadohar Rly. Station. Well connected by roads with comfortable Bus service.
Nearest Airport—Ranchi—175 kms.

For further particulars write to :

THE FIELD DIRECTOR, PROJECT TIGER,
Palamau Tiger Reserve,
P.O. Daltonganj, Bihar, (India)

WHATEVER YOUR NEED

There is a Species of

ANDAMANS TIMBERS

TO SUIT YOUR REQUIREMENTS

CONTACT :

1. The Chief Conservator of Forests,
Andamans & Nicobar Islands,
Port Blair

2. The Deputy Conservator of Fores
(Depot Division)
Andamans Govt. Timber Depot,
3-A, 2nd Floor, Auckland Place,
Calcutta-17.

3. The Assistant Conservator of Forests,
(Depot Division)
Andamans Govt. Timber Depot
Marshalling Yard, Port Trust, MADRAS.

FOREST RESEARCH DIVISION
RANCHI-834002 (BIHAR)

Under tribal sub-plan we produce and sell following goods every year :

* Sealing Wax
* French polish
* Seed lac
* Sisal fibre suitable for rope making.

Interested buyers should contact :

FOREST RESEARCH OFFICER,
BIHAR
FOREST RESEARCH DIVISION
P.O. HINOO,
RANCHI-834002 (BIHAR)

Associate yourself with the

INDIAN FORESTER

as

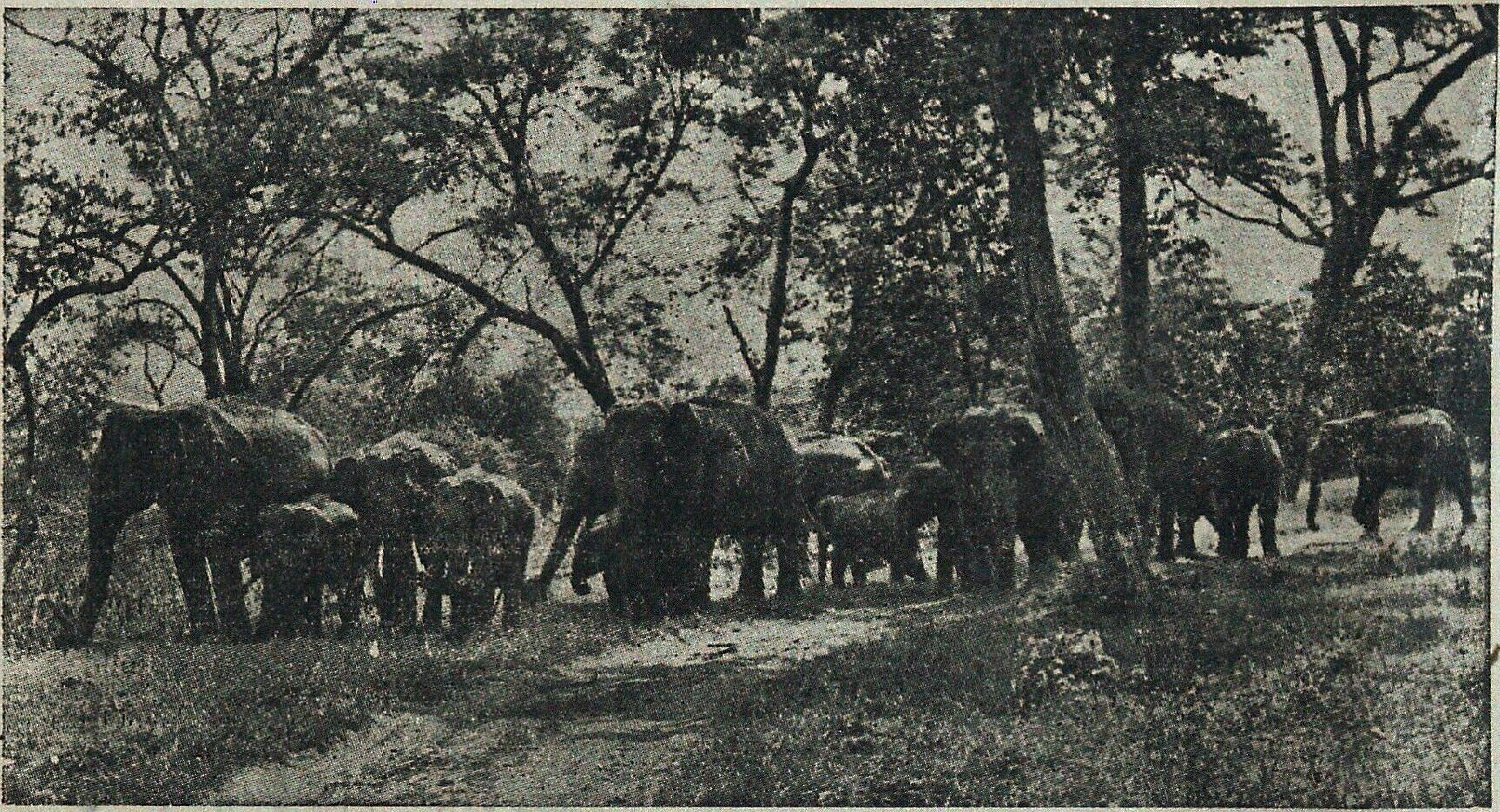
Advertiser—Subscriber

or

Contributor

BANDIPUR TIGER RESERVE

KARNATAKA



Lovers of nature and Wildlife the world over find it well worth their while to linger on in Bandipur. More famous as a Tiger Reserve, Bandipur enjoys reputation as a wildlife sanctuary that stretches as far back as 1931. The Mysore Maharajas; benign rulers and farsighted visionaries understood the compelling necessity of protecting the fauna, avifauna and flora from the thoughtless foreys of marauders. Today 874 sq kms. of the Bandipur National Park makes up the Tiger Reserve which is one of India's finest parks.

But Tigers, native to the country and the most magnificent of the great cats are saved from threatened extinction. An abundant variety of fauna: the panther, wilddog, Sloth bear, Sambar, Chital, barking deer, fourhorned antelope, common langur; avifauna like peacock, grey jungle fowl, crested hawk, eagle and reptiles such as crocodiles, Python, Vipers, etc., roam this park freely.

Hundreds of spotted deer greet the visitors right at Bandipur campus, at night times as they step out of comfortable cottages.

A herd of elephant majestically moving single file through a patch in the jungle can be viewed on an elephant ride. If one is lucky he can watch in absolute silence, of course—a herd of Indian 'bison' or gaur, locking horns a few meters away.

Nature at its bountiful best—Bandipur bestows the soothing solace of jungle retreat off the beaten track and far from the madding crowd.

For further particulars, please contact

The Field Director
'Project Tiger'
Government House Complex
MYSORE 570 010
(Karnataka—State) India
Telephone No. 20901

FOREST SERVES ALL

- We have sale centres at Salt Lake Calcutta, Durgapur, Bankura, Purulia and Midnapore for superior quality Sawn timber and Plywood for making doors and windows. Black Board and Readymade furniture are also sold at reasonable price.
- If you intend to purchase readymade door, window, flushdoor and furniture please contact the Salt Lake Sale Centre at Calcutta, Govt Saw Mills at Siliguri or the Saw Mills at Madarihat. We will meet your requirement or arrange supply of materials of your choice.
- Good news to the pan chewers also, we are producing good quality of Khair (Katha) and selling this in polythene packets of 10 Gms., 25 Gms., and 100 Gms. from our sale centres. If any chewer has used this once he will never forget to purchase again and again.
- Pure Honey, Citronella Oil, Orchid and various flowers are also available from the sale centres.

West Bengal Forest Development Corporation Limited

(A Government of West Bengal Undertaking)

6A, Raja Subodh Mullick Square (7th floor)

Calcutta-13

PUBLIC NOTICE

Public is hereby informed that Messrs. National Geographic Society (USA), Anglia Survival (UK), British Broadcasting Corporation (UK), National Film Board of Canada, Coronet Instructional Films (USA), Aims Media (USA), are world renowned producers of Educational and Instructional Films including Films on subjects related to Wildlife and Forestry etc. Among their productions are also included the following titles :

1. About Sharks
2. Elephant's Eye View
3. Fastest thing on Four legs
4. Konrad Lorenz : Science of Animal Behaviour
5. Land of the Tiger
6. Last Round up
7. Leopard that changed its spots
8. Monkeys, Apes and Man
9. Rain Forest (Moist Tropical Forests of Costa Rica)
10. Tiger Tiger

The copyright of each of these among their other Films vests exclusively with the respective producer.

We, the undersigned are the exclusive representative of the said producers in India for the purposes of Distribution, Exhibition and Exploitation of their Films and Video Cassettes throughout India. Our said Principals have not permitted, anyone else to deal with their Films and Videocassettes in any way in India.

It has come to our Notice that some Parties have pirated and made unauthorised Video Copies of several of their Films including the above Titles and are offering the same for sale.

Public is hereby warned that Copying, Selling, Purchasing and Exhibiting such Video Copies is a Criminal Offence under the existing Law and suitable Criminal and/or Civil action will be taken against the persons who unauthorisedly take out Video copies and/or offer the same for Sale, Distribution or Exhibition as well as against Persons or Bodies acquiring such unauthorised Video Copies.

Before initiating any such action, we would like all those who may have unknowingly acquired any Videos of any of the Films Produced by the above named Producers including the above Titles from any source other than US, to write to us giving relevant details such such as titles purchased, from whom purchased and the amounts paid for the same to enable us to see whether the Videocopies acquired can be allowed to be used by the buyers.

Sd/- G.D. Aggarwal
Director
National Education & Information Films Ltd
National House, Apollo Bunder
Bombay—39

Dated This Sixth Day of May 1989

THIRTEEN YEARS OF ACHIEVEMENT THIRTEEN YEARS OF PROGRESS

Madhya Pradesh Rajya Van Vikas Nigam Limited

Panchanan, 5th Floor, Malviya Nagar, Bhopal

Rededicates itself for rehabilitation of Green Glory

76162 ha of Teak Plantation
33781 ha of Bamboo Plantation
1586 ha of Tropical Pine Plantation
3303 ha of Industrial Plantation
39987 ha of afforestation under Drought Prone Area Programme
334 ha R.K.M. length of Avenue plantation
3708 ha of Mixed plantation
8382 ha of pasture Development

Modest contribution of setting up of Forest based industries

- Bastar Wood Products, Jagdalpur a Joint venture
- Narmada Wood Products, Itarsi our sole Enterprise
- Polythene bags Manufacturing in Itarsi
- Supply of food to labourers under World Food Programme
- Supply of (9.10 Lakhs) Sal Sleepers to Indian Railways
- Amelioration of Rural people through Training and Employment in Wood Craft Centres
- Annual employment of 40 lakhs Mandays
- Annual Labour Payment of Rs. 10 Crores
- Labour Welfare Schemes of Rs. 2.58 lakhs

With Best Wishes

(M.P. Vashishtha)
Chairman

(S.N. Khare)
Vice Chairman-cum-Managing Director

RULES OF CONTRIBUTIONS

1. Contribution should be sent to the Honorary Editor, *Indian Forester*, Forest Research Institute, P.O. New Forest, Dehra Dun, or to any Member of the Board of Management or Central Editorial Board and should be written legibly in ink *preferably* typed.

2. The Central Editorial Board does not hold itself responsible for the opinions expressed by the authors.

3. The Central Editorial Board reserves the right of accepting or rejecting any contribution and of making suitable alterations and amendments, without assigning any reason.

4. Contributors are invited to sign their contributions in preference to affixing to them a *non de plume*, since professional opinions naturally carry more weight when their author is known. All communications must be authenticated by the name and address of the writer being communicated to the Honorary Editor, whether intended for publication or not.

5. Contributors will be supplied with 30 extra copies of their contributors, together with any illustrations accompanying them, free of charge. Additional copies will be charged for at the rate of fifty paise per page per reprint. *Contributors desiring extra copies should state the number required when sending articles, otherwise they will not be available.*

6. No payments will be made to members of Govt. organisation for their contributions to the *Journal* but it will be open to the Honorary Editor, to make payments for articles accepted from the outside public.

INSTRUCTIONS TO CONTRIBUTORS

Title—This should be brief, carefully chosen, and indicative of the contents of the article. It should be inserted on the top of the first page in block capitals.

Authors—The name of the author and his status should appear immediately, under the title, but need not be entirely in capitals.

Introduction—An introduction presenting the general object of the work, and the scope and importance of the problem is, desirable.

Presentation—The matter should be neatly written, or typed double or treble spacing, on one side only of fullscape size paper with a left hand margin of 4 cm and margins of 2.5 cm at the top and bottom of each page except the opening page where the top margin should be 4 cm. The sending of the contributions in triplicate is recommended.

Summary—A condensed account of the important contents of the article should be at the end of article. The summary should be self-explanatory, complete and clear in itself, avoiding, as far as possible, technicalities.

Illustration—The number of illustration should be kept at a minimum as their reproduction is costly. Photographs and drawings should, if possible, be made to the correct proportion of the printed page of the magazine (20 cm by 15 cm). Nothing should be written in pencil or ink, or typewritten on the back of illustration as they cause trouble in reproduction. Photographs and illustrations should not be pinned or sewn with thread as such pin holes reproduce in photography. The former should be in black and white, with pronounced contracts and glossy finish : the later should be neatly drawn in Indian ink on white thick paper or drawing paper. Graph paper should preferably have black co-ordinate lines on white background. Captions should be typed or written on separate strips of paper and attached with colourless adhesives to the back of the prints. The approximate place where the illustrations are to be inserted should be indicated in the text, and the illustrations should be serially numbered. In mailing Illustrations should be placed between cardboards held together by thin thread or rubber bands.

Copyrighted pictures or photographs from commercial photographers should not be sent.

Punctuations—Authors should pay special attentions to punctuation as this greatly aids the reader in understanding the author clearly; if this is left to the editor, a wrong punctuation made by him may alter the author's intended meaning of a sentence.

Citations—The Bibliography should be given at the end of the article on separate sheet of paper and should be typewritten double-spaced throughout. Reference to a citation in the text should be made by means of the author's name followed by a reference number in parentheses. In the bibliography the citation should be preceded by the reference number. The citation will consist of the serial number, the author's name and initials (in large and small capitals), the year of publication, the title of the article, the title of the book, paper or periodical, volume number and date of issue and the page numbers, thus:

Hamilton, A.P.F. (1947). Farm Forestry in India, *Indian For.*, 74 (3), 84-88.

Corrections—Authors are requested to see that their typescripts incorporate all corrections they desire to be carried out as no revisions are permitted by the press in the proof stage and any resetting involves heavy cost.

Capitals—Normally, typewritten or handwritten matter should show where capitals are to be used. If a whole word or line has to be printed entirely in capitals the original should also be so written. To indicate italics a single straight line should be drawn under the matter concerned in the original text.

For detailed instructions see the editorial in the *Indian Forester* of May 1950.

THE
INDIAN FORESTER

VOLUME 115 APRIL 1989 NUMBER 4

CENTRAL
EDITORIAL BOARD

R.V. SINGH, I.F.S. (President)

G.P. MAITHANI, I.F.S. (Hony. Editor)

S.K. PANDE, I.F.S.

RAMESH DAYAL

Edited by G.P. Maithani I.F.S., Honorary Editor, Indian Forester (Director, Forest Research Institute, Dehra Dun), Published by B.S. Beniwal, I.F.S., Business Manager, Indian Forester (Assistant Silviculturist (G), Forest Research Institute, Dehra Dun) and Printed by S.K. Arora at Print World, Dehra Dun.
Cover printed at Indraprastha Press (CBT), Bahadurshah Zafar Marg, New Delhi-110002.

Registered No. **D.N. 36**